DIMENSIONS NBS

The magazine of the National Bureau of Standards U.S. Department of Commerce

July/August 1978

TRAGEDY OF FIRE. See page 10.

COMMENT

THE ELECTROMAGNETIC ENVIRONMENT

We are witnessing a rapid proliferation of sources of electromagnetic radiation. Wider use is being made of Federally authorized frequency bands for industrial, safety, law enforcement, broadcasting, citizens bands, and defense applications. Sources of electromagnetic radiation include the 9 million transmitters authorized by the Federal Communications Commission (FCC) as of 1977, including the 4,500 AM and 4,000 FM radio stations and 1,000 TV stations; point-to-point microwave communications relay towers, satellite ground stations, the 40,000 circuit miles of overhead extra-high voltage (345 to 765 kV) AC electrical transmission lines; and the 30 million citizen's band radios estimated to be now in use.

Added to this list are those sources of electromagnetic energy used for consumer, industrial, scientific, and medical purposes. These include microwave ovens (an estimated 2 million in use), arc welders, combustion engine ignitions, electric motors, high voltage switches, and intrusion protection systems.

We are also witnessing an applications explosion resulting from remarkable technological advances in semiconductor technology that have led to breakthroughs to lower prices, to increased effectiveness, and to new electronics applications.

Unfortunately, these electronic devices are susceptible to interference from stray electromagnetic radiation whose effects may range from a temporary disruption of function to subtle alteration of commands in a microprocessor, to product failure. A different aspect of the problem is the effect of electromagnetic radiation on living organisms. Research is going on elsewhere to identify these effects and to assess degrees of hazard.

Right now, it is difficult to predict levels for electronic equipment at which deleterious effects may occur because information available on the electromagnetic environment is relatively limited. Sound measurement methods and instrumentation such as those being developed by NBS will be required for characterizing the electromagnetic radiation environment and more fully understanding the possible equipment function disruptions and biological impacts.

Similarly, in order to regulate the electromagnetic environment in a rational way, we need to be able to characterize stray electromagnetic radiation. The heart of the problem is that there is an inadequate base of measurement techniques for establishing either the total electromagnetic environment at any point in time or the susceptibility of electronic systems to that electromagnetic environment.

As valid methods of measurement and instrumentation become available, however, it is becoming possible to survey the electromagnetic fields and power levels surrounding those sources most likely to cause interference—that is, the high-power, fixed transmitters and mobile transmitters of even moderate power—and to interpret the results. It is our belief that the competence in NBS for measurement and instrumentation can make valuable contributions to solutions of this problem.

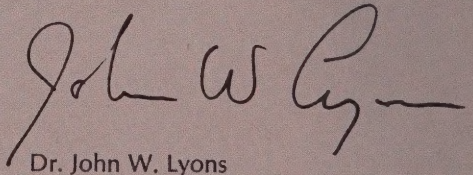
It is clear that the electromagnetic environment must be controlled to allow effective use of communication equipment. In the federal government, there are agencies with the authority and responsibility for overseeing and regulating electromagnetic radiation with respect to its interference with electronic equipment. The voluntary standards community can play an important role in developing consensus on standard test methods. In addition we need to have careful economic analysis of the effects of various options.

There are also government agencies that oversee and regulate electromagnetic radiation with respect to its health effects. Other agencies, by virtue of their importance both as producers of environmental radiation and as users of radio communications equipment, have a major stake in the issue.

In order to carry out their responsibilities properly, all of the concerned parties require consistent and compatible measurement methods to determine the appropriate characteristics of stray electromagnetic radiation. The provision and coordination of these measurement methods is the role and responsibility of NBS.

The appropriate government role is quite different with respect to equipment such as electronic control equipment for which it may be technically feasible to provide shielding or protection from the electromagnetic environment. In this case, the burden of solving the interference problem falls more with the manufacturer of the equipment rather than through control of the electromagnetic environment. Though in some situations a special issue of safety would fall within the purview of a government regulatory agency, this aspect of the interference problem in general involves more the private sector and voluntary standards community.

Along with the provision of appropriate measurement and test methods to regulatory agencies, NBS has a long history of close, cooperative, and fruitful relations with voluntary standards organizations. The maintenance and growth of both of these relationships will be important as NBS contributes to solving the problems of the electromagnetic environment.



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YOU are probably already familiar with some uses of automation* by businesses and banks. Your bank statements, credit card bills, and department store bills may be prepared by computers. Computers process your airline and hotel reservations. Computers have been used for recordkeeping, customer billing, and check processing for many years because computers process information quickly and accurately.

Then, too, you may have used automatic machines such as toll collectors and gasoline pumps that are activated when money or credit cards are inserted.

You will soon see new uses of automation in the marketplace: automated cash registers and bank teller machines. These automated registers and tellers are computer terminals—devices that communicate with computers. The terminals send information about a transaction to a computer and receive instructions from the computer as to how to proceed with that transaction. The computer is often located far from the terminals. The terminals can also be linked to other devices that read codes and label information.

Businesses and banks are using computers to:

- speed up customer transactions,
- help prevent mistakes, and
- collect useful information for both consumer and business records.

To help you better understand some of the recent changes in the marketplace, this booklet describes new uses of computers and automation by the grocery, retail, and banking communities.

* Automation means the automatic operation of a process or a machine.

AUTOMATION IN THE MARKETPLACE

by
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National Engineering Laboratory
National Bureau of Standards

This article is a reprint of NBS Consumer Information Series 10. Ordering information will appear on the News Briefs *page of September DIMENSIONS.*

THE GROCERY INDUSTRY

SOME grocery stores are using computers to assist at the grocery checkout counter. The computerized checkout system generally consists of a laser scanner (reading device using a laser beam) and an electronic cash register that are connected to a computer.

The automated checkout operation eliminates the need to ring up manually the price of each grocery product. Instead, a scanner reads a

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special marking on the product and a computer looks up the product's price, which is then automatically recorded on the cash register.

Universal Product Code

You have probably noticed the vertical bars that appear on canned and packaged products in grocery stores. This marking represents the Universal Product Code (UPC)—a standard system of marking for labels, adopted by the major supermarkets, food manufacturers, processors, and distributors. The UPC identifies the grocery item and is printed on the label by the manufacturer at the time of food packaging.

The bars and spaces of the UPC represent ten digits that identify the manufacturer or the brand and the particular product, its flavor, and size. The UPC does not contain the price of the item. A briefer six-digit code appears on some items such as chewing gum—a special adaptation designed for small packages.

The bar code can be used on products other than food:

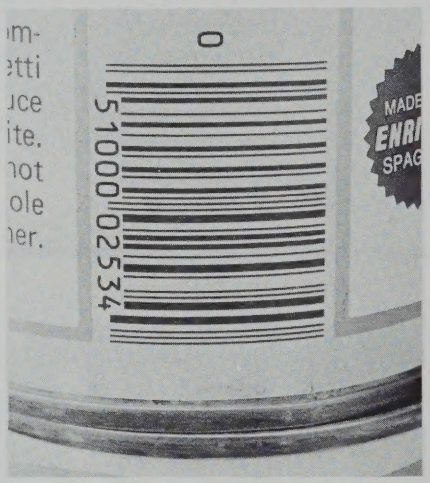
Nonprescription Drugs. The National Drug Code assigned by the Food and Drug Administration can be printed on labels and used as the UPC.

Medical Products. The code assigned to other medical products such as bandages (National Health Related Items Code) can also be used as the UPC.

Other Non-Food Items. Additional items such as alcoholic beverages, books, magazines, stationery and business supplies, and electrical supplies have been assigned compatible codes.

Laser Scanner

The UPC is read by a scanning device containing a low-energy laser installed at the end of the checkout counter. The UPC marking is designed so that it can be read sideways, upside down, or from any direction, as long as the bar code is facing the scanner. As the checker slides the item across the scanner, the laser scanner reads the UPC and



transmits the data to the computer. Laser scanners used in grocery checkout operations have been tested and approved as safe for both checker and consumer.

Computer

The computer receives the product information from the laser scanner and finds the item in the computer file. The computer looks up the price and other information about the product; for example: Is the item taxable? Is it eligible for food stamp redemption? Is there a bottle deposit? This information is immediately flashed back to the cash register.

The computer which stores the product and price information can serve about 50 terminals and may be located in the grocery store or in a remote location such as the grocery company's headquarters office.

Electronic Cash Register

In some systems product identification and price information are displayed for the consumer on an electronic viewer at the checkout counter. At the same time this information is printed on a receipt tape and a "beep" is sounded by the cash register to indicate that the price has registered.

Handling of Uncoded Items

Items not marked with the UPC can be rung up manually on the cash register by the checker. Almost all packaged items will be marked with the UPC within the next few years.

Most fresh meats and fish packaged in the store are not marked with the UPC. However, grocery stores can buy equipment to apply UPC labels to these items so that they can be scanned and automatically rung up. Unpackaged items such as fresh fruits and vegetables are usually not coded. Electronic produce weighing-computing scales can be incorporated into the computerized checkout systems.

Electronic Sales

Loose produce can be weighed on an electronic scale that is linked to the computer and the cash register. The store assigns a commodity code to each item of produce. The checker places the item on the scale and enters the code into the terminal. The item is weighed and its price is computed automatically. Both weight and price are flashed on the display and printed on the receipt tape.

Another way of handling produce is with an electronic scale not connected to the computer. Here the checker enters the price per pound into the scale. The scale computes

the total price and the checker manually rings up that price on the register.

Weights and Measures Enforcement

"Weights and measures" enforcement officials* are responsible for testing scales for accuracy and checking labels on products for correctness. Weights and measures regulations are established and enforced at the local and state levels of government. These state and local officials are also responsible for enforcing requirements for specific information on the new computerized receipt tapes. This consumer protection service helps to assure equity and fairness in market-type transactions to protect both buyer and seller.

Special Features of Computer Checkout Systems

Computerized checkouts offer some new convenience features and potential opportunities for better service for consumers:

• *Computerized checkout reduces errors and makes calculations easier.* Since most prices will be rung up on the cash register automatically, there will be fewer errors caused by the checker entering the wrong price.

Taxes, totals from items eligible for food stamp redemption, merchandise and bottle refunds, coupon redemption, trading stamps, and change also can be computed automatically.

If the consumer does not want an item that has been scanned, the checker can push a button on the cash register and rescan the item. The amount of the item will be deducted from the total.

• *"Two-for" and "Three-for" items do not have to be grouped together.* Even when these items are scattered and not checked out together, the computer automatically keeps track of them. In the case of three items for 29 cents, for example, the customer will be charged 10 cents for the first item passed over the scanner, 10 cents will be rung for the second item, and, even if many other items are scanned in between, only 9 cents will be charged for the third item.

• *Computerized checkout can provide more detailed receipt tapes.* The name of the product and its price as well as the price per pound for

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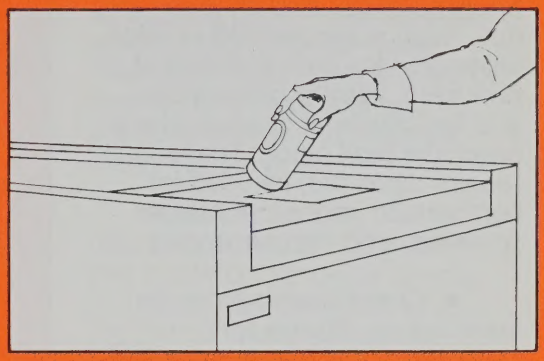
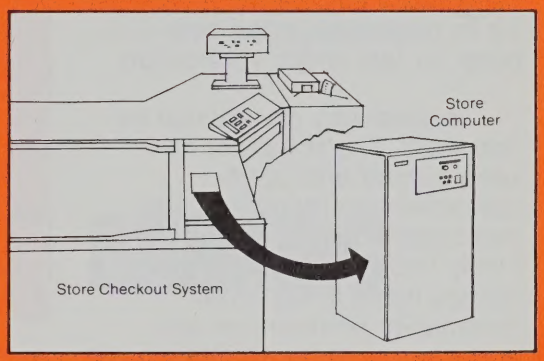
*A weights and measures directory listing enforcement officials in each state and copies of model weights and measures laws and regulations are available from the Office of Weights and Measures, National Bureau of Standards, Washington, D.C. 20234

THE GROCERY CHECKOUT SYSTEM

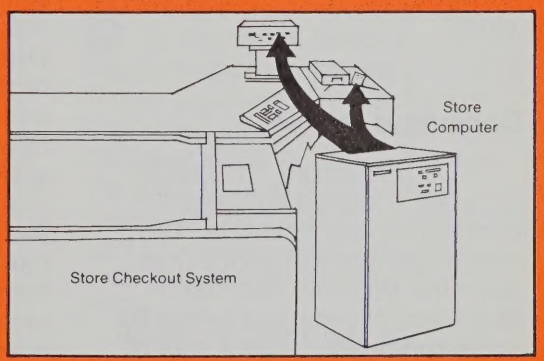
As the checker moves the UPC marked item across the scanner, the product information is read.



The information is transmitted to the computer which looks up the price.



Then the price is flashed back to the checkout terminal where it is displayed on the viewer and printed on the receipt tape.

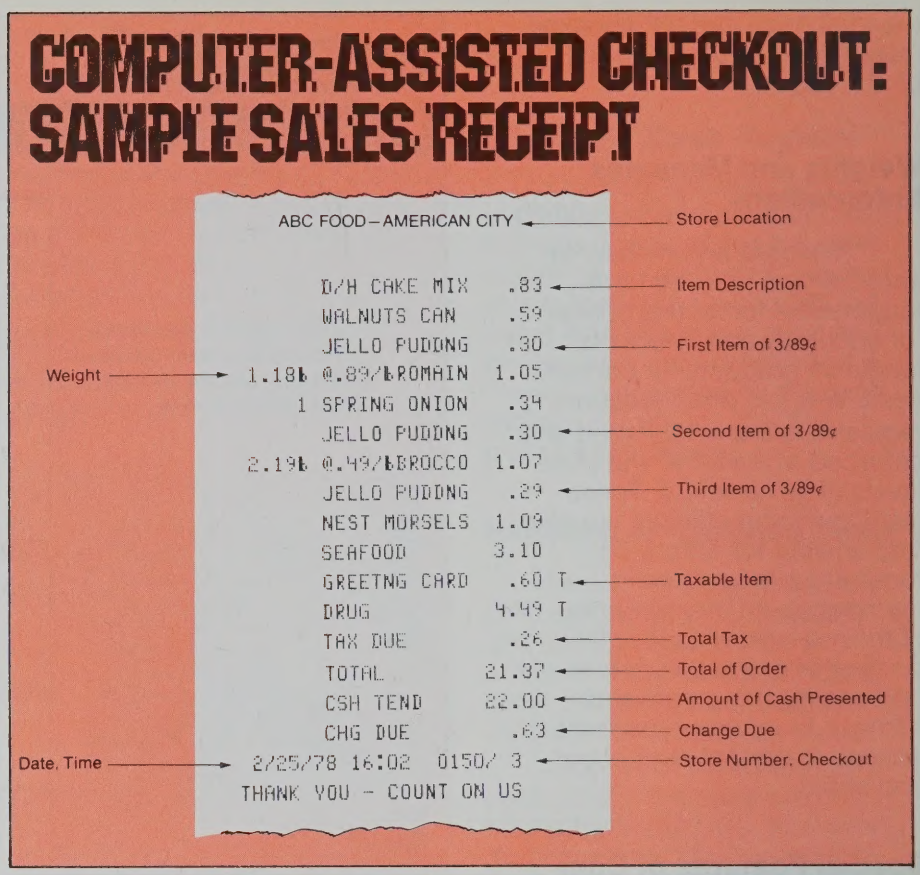


produce and meats are usually printed on the tape.

In addition to the total price, sales tax, and change due, most computerized receipt tapes give the date and time of purchase, identity of the store, and the checkout counter where purchase took place. These receipt tapes can be used for comparison shopping, budget planning, and recordkeeping.

- *Check cashing can be speeded up.* Stores can keep check cashing information for its customers in the computer for fast check verification.

- *Inventory control can be improved.* The computer can keep current and up-to-date inventory records. It also can supply managers with timely information about how quickly items move, what community preferences are, and when to order additional stock.



Consumer Issues

Computerized checkouts have also created some concerns among consumers. The most controversial aspect has been the possible elimination of individually marked prices by some grocery firms as a way of saving labor costs. According to these firms, with product and price information stored in the computer, the checker does not need to refer to a price stamped on each item. Instead, item prices can be posted on shelf labels. Grocery firms using computerized checkouts are testing consumer reaction to the continuation or elimination of individually stamped prices.

Consumer groups support the continuation of marked prices. They say that shelf labels can be misplaced and may be difficult to read. Marked prices on products make it easier to compare the costs of different brands, to check the price charged at the cash register with the marked one, and to compare the cost of a newly purchased item with one at home.

A recent study conducted for the supermarket industry compared consumer price awareness in computerized checkout stores using only shelf prices with price awareness in conventional stores using shelf and individual item pricing. Some reduction in consumer price awareness occurred when item pricing was removed. As a result of that study, the supermarket industry has recommended that stores continue the practice of price marking individual items while alternative methods of disseminating price information are discussed with consumer and labor groups.

In the meantime, legislation has been introduced in Congress and in several states requiring individually marked prices. At least 6 states and 18 cities already have laws with this requirement.

Some other issues raised by consumer groups are:

- Computerized records of customers' check cashing histories could create a threat to the privacy of the consumers who pay by check.

- The high cost of computerized equipment may be passed on to the consumer in the form of higher prices.

- Incorrect prices may be coded into the computer.

The Future

Supermarket firms will probably change over to computerized checkout systems in new and remodeled stores. Consumer reactions to computer-assisted checkout and specific preferences for price marking will be important factors in determining how that changeover takes place.

RETAIL STORES

POINT-OF-SALE (POS) terminals that are linked to computer systems are replacing conventional cash registers in department stores and other large retail establishments. The POS terminals assist in the checkout operation and help managers operate more efficiently by providing more timely inventory information.

The POS terminal—an electronic cash register—at the checkout counter collects information about the sales transactions and records it in a form that can be transmitted to a computer. At the present time, some checkers are manually ringing up merchandise information in the cash registers. However, many of these terminals soon will be equipped with a hand-held scanner or "wand" to read merchandise labels automatically.

National Merchandise Code

The National Retail Merchants Association, with the technical assistance of the National Bureau of Standards, has adopted a voluntary standard system for marking merchandise. This system is based on agreements reached among retailers, merchandise manufacturers, and business equipment suppliers.

The merchandise marking system uses a specially designed set of numbers and letters that can be read by automatic reading devices and by the consumer. The type style looks very much like the letters of the alphabet and the Arabic numerals in everyday use.

Reading Wand

The hand-held scanner or "wand" is linked to the POS terminal and reads the specially printed characters on the merchandise label. The label can be scanned from left to right, or from right to left, and does not have to be removed from the merchandise.

Price and merchandise information is transmitted by the wand to the POS terminal.

Point-of-Sale Terminal Systems

The terminal receives the price and item information. In some systems the terminal stores the information for later transmission to a computer for processing. In systems that are directly connected with a computer, the terminal sends the information to the computer for immediate updating of inventory records.

The terminal totals the customer's bill and computes the tax. The operator is guided through the transaction by a series of messages that light up on the terminal.

Price calculations—multiplying and discounting—can be done automatically to reduce arithmetic errors. The terminal, when linked to the computer, can be used to verify the customer's credit and to authorize checks.

The electronic terminal prepares a detailed receipt for the consumer showing item purchased, the sales department, any credits allowed, taxes, method of payment, and amount of change. POS terminals linked directly to the computer can also send information about credit transactions.

Special Features

- *Easier checkout.* The automatic reading of merchandise labels can make the collection of information about sales faster and easier.

- *Better inventory control.* Retailers hope that with better inventory control they will be able to keep their shelves well stocked with popular items. They also hope to better control their store's cash flow and credit operations to improve customer service.

- *Extra services.* Terminals connected to computers can be used to provide special customer services such as asking the computer about the availability of an item in another store or in the warehouse.

BANKING

BANKS are using computers to exchange funds instantly without paperwork. These paperless transactions are called electronic funds transfers (EFT's). EFT's involve the exchange of money by means of computer generated and processed electronic records rather than by checks or cash.

Electronic banking can help banks reduce the costly processing of more than 26 billion checks a year, costs borne indirectly by the consumer. Electronic banking can also mean conveniences such as neighborhood bank teller machines and automatic payroll depositing.

The technology for a shift from checks and cash to electronic banking exists today. However, there are many unresolved societal, legal, and regulatory issues. How will individual privacy be safeguarded?

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How will fraud and errors be prevented? Will small banks be able to compete?

The National Commission on Electronic Funds Transfer was established to study the impact of electronic banking and to report its recommendations for legislation and regulation. Full scale implementation of electronic banking will be delayed until the regulatory agencies and the legislatures can consider the Commission's recommendations.

Current Forms of Electronic Banking

Banks have used computers and automated equipment for many years to process the millions of checks that are written every day. At present, some banks offer electronic banking services to their customers including: pre-authorized deposits and payments, automated teller machines, and other automated services.

Preauthorized Deposits

The direct deposit of an employee's pay into his/her checking account can be done by an electronic funds transfer or by the deposit of one check covering many employees, reducing check preparation and mailing costs. Some welfare and Social Security checks are deposited this way.

Direct deposit arrangements can help consumers by:

- saving time in cashing checks.
- providing funds even though the check recipient may be on vacation, ill, or away on a business trip.
- eliminating the danger of lost or stolen checks.

Most automatic deposit programs guarantee the deposit. However, consumers may be dissatisfied if banks do not send confirmation of the receipt of deposits and merely include them on the regular statements prepared by the bank.

Preauthorized Payments

Some banks offer an automatic payment service to their customers. The customer authorizes the bank to pay recurring bills such as mortgage payments or to transfer funds between savings and checking accounts. These arrangements are useful to banks because they eliminate transaction paperwork and reduce item processing costs.

The consumer benefits by:

- reducing trips to the bank,
- saving postage to pay bills, and
- knowing bills will be paid in time to benefit from discounts and grace periods.

On the other hand, consumers may feel that they have lost control over how their money is spent. They may also miss being able to manipulate their bank accounts and take advantage of "float".*

*"Float" is the time between the issue of a check and its clearance at the bank. This time lag makes it possible to write checks before funds to cover them are actually deposited.

The computer terminal permits bank transactions 24 hours a day. The customer can withdraw cash, make deposits, and transfer funds between accounts.

Automated Teller Machines

The bank customer can use the automated teller machine at almost any time to withdraw cash, to transfer funds between checking and savings accounts, and to make deposits and some payments such as loan installments. The customer inserts a plastic card into the terminal and is guided through the transaction by a series of instructions that appear on the terminal.

Other Automated Bank Services

In some states, POS terminals located in stores are linked with banks. Consumers can authorize electronic funds transfers by inserting a card issued by the bank into the terminal. They can cash checks and pay for their purchases in the retail stores by transferring funds from their accounts to the retailer's account.

Consumers are also paying bills by phone rather than by writing checks. They can call their banks to authorize the transfer of funds to retailers or utilities from their accounts.

Privacy and Security

Most people consider information about their financial transactions to be private and do not want that information to be used for anything other than banking purposes. They also would not want data about financial transactions to be used for surveillance—keeping track of where they shop and where they bank. Individual privacy and the public interest are issues that are being addressed by the National Commission on Electronic Funds Transfer.

The Federal government is also looking for ways to prevent privacy invasion, fraud, and crime in computer use. The National Bureau of Standards has developed methods and guidelines for encrypting* computerized information and for verifying the identification of people seeking access to computers. These techniques for improving computer security are useful not only to the Federal government but also to the retailing and banking communities.

*Encryption involves electronically scrambling computerized data into an unintelligible form for transmission between a terminal and a computer or between computers. Only those users who are authorized to receive the data have the key to return it to an intelligible form.

The Future

Bankers are planning a system that will allow you to purchase goods and pay electronically from your bank account through the use of a nationwide card.

Automated banking systems of the future may greatly reduce the consumer's need for carrying cash or a checkbook. The development of these systems will be shaped by many forces—the acceptance of the consumer, the competitiveness of banks, government regulation, and new technology.

CONCLUSIONS

THESE computer applications by banks, grocery, and retail stores may be the beginning of new ways of doing business. Automation can benefit both the consumer and business by improving services while helping business to control its costs.

There are, of course, many unresolved problems and concerns that must be addressed by government, labor, business, and consumers before automation is accepted as a familiar and welcome part of the marketplace. □

SCIENCE FOR LIFE

Harmer House Convalescent Home on January 10, 1970. The fire of January 9 cost the lives of 32 of the home's 46 patients, but did little structural damage to the building.

by David Chaffee

JANUARY 9, 1970—Marietta, Ohio. Fire breaks out in a room of the Harmer House Convalescent Home. One of the attending nurses at first believes the fire can be doused with a small extinguisher, but the flame soon spreads from the room to the corridor outside and blazes down the hall, using the carpeting as its fuel. The fire does little structural damage to the building, yet only 14 of the 46 patients survive.

• The Harmer House Convalescent Home tragedy, and other fatal blazes similar to it, convince researchers that the old assumption that floor coverings do not play a significant role in the spread of fire is a myth. Three tests on carpeting found in the Harmer House show that while the carpeting is not so flammable that it bursts into flames from a small ignition source such as a cigarette, it is "capable of propagating [spreading] flame"* once it is ignited, depending upon circumstances.

• Concern grows in the federal government with regard to corridor fires in multiple occupancy buildings. A flammability test for carpeting (the methenamine pill test developed by the National Bureau of Standards and initiated before the Harmer House tragedy) is introduced in the *Federal Register* in April 1970. The test determines whether or not carpeting will burn when exposed to a small, flaming ignition source, such as a lit methenamine pill (a common chemical manufactured in pill form) placed in the center of a carpet sample. The pill test is valid for the purpose it is intended to serve, but it tests for only one type of hazard—ignition by a small flaming source. Carpeting taken from the Harmer House passes the pill test.

• Several months after the Harmer House fire, the U.S. Department of Health, Education, and Welfare asks NBS to develop a program on corridor fires so that a suitable test method for floor coverings can be devised. The hope is that such a test can reveal under what conditions a specific floor surface will propagate a flame.

This is the story of the searching and testing by NBS—aided by private enterprise—that has resulted in a federally accepted test which provides a better indication of the behavior of floor surfaces in corridors during fire. This, in turn, has led to a system that ranks floor surfaces according to their fire behavior.

The availability of such a tool reduces the chances that the Harmer House tragedy will be repeated elsewhere.

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COVER STORY:

This article traces the evolution of one of the standards developed at the National Bureau of Standards in support of fire safety in buildings.

Chaffee is a DIMENSIONS staff writer. This article is based mainly on research conducted over a period of seven years in the National Bureau of Standards' Center for Fire Research. It was supported in part by the Department of Health, Education, and Welfare; the Veteran's Administration; the Department of the Navy; and the General Services Administration.

**Albert B. Sears, Jr., "Nursing Home Fire—Marietta, Ohio," Fire Journal, May 1970, reprints available from the magazine for $1.*

Engineering technician Thomas Prather demonstrates the use of the flooring radiant panel apparatus at the National Bureau of Standards.

The Search Begins

The NBS Program for Corridor Fires is based in the Center for Fire Research. Irwin Benjamin, currently chief of the Fire Safety Engineering Division, has been the program's general supervisor and coordinator since its inception in 1970. His idea of using a full scale "typical corridor" to run fire tests got the program underway.

Clayton Huggett, now chief of the Office of Extramural Fire Research, supervised the initial program on a day-to-day basis. Huggett outlined the program's first phase as follows: (1) to characterize the fire environment to which floor coverings are subjected in building fires, (2) to identify and quantify the hazard characteristics of floor coverings in building fires, and (3) to suggest test methods suitable for measuring the hazard potential of floor coverings under building fire conditions.

Taking into account the convalescent home blaze, NBS researchers designed a full scale corridor and adjoining burn room. "The essential features of the nursing home fire were duplicated," explains Huggett. The "typical" corridor was 9 meters long, 2.4 meters wide, and 2.4 meters high. The burn room was 2.4 meters by 2.4 meters by 2.7 meters. Four wooden cribs* weighing approximately 20 kilograms apiece were placed in the burn room and ignited to initiate a test.

Miles Suchomel, an Underwriters' Laboratories, Inc., employee with experience in fire-related testing, joined the corridor program as a research associate** in October 1970 and stayed for 18 months. Suchomel, who worked with NBS fire researchers Francis Fung and Philip Oglesby, was the first of four such associates from private industry to spend full time on the Corridor Fire Program.

In the 20 or so tests conducted by the research team, the floor covering was one among several variables. Others included size of the room fire, ventilation in the corridor, and wall and ceiling lining. Usually, fire behavior observed in the tests followed this sequence of events: "Shortly after the carpet ignited in the burn room, a flame was observed to spread slowly over the carpet surface from the burn room and then to accelerate. Then the corridor would flame-over, with flame following the entire surface of the carpet."*** The NBS researchers used the term "flame-over" to describe the way the fire swept quickly from one end of the corridor to the other, feeding on the floor covering as it went.

Heat Radiation Becomes a Factor

The full corridor study was directed primarily at characterizing the fire environment and identifying and quantifying the hazard characteristics of floor coverings. However, one phenonemon the researchers observed in the full scale tests also gave them insight concerning laboratory test methods that might be used to measure the hazard potential of floor coverings: Suchomel, Fung, and Oglesby found that heat from the fire in the burn room contributed to preheating the floor covering in the corridor before the flames reached that area.

In their report, they concluded, "Both temperature and velocity measurements indicate that radiation rather than convection is the dominant heat transfer mode that causes carpet flame-over in the corridor." This meant that there was more to a corridor fire than the simple spread of a flame from the ignition room. It meant that an additional element—externally imposed heat radiation—was instrumental to the flame's spread. It suggested that a laboratory test that included this element would be the most promising kind for further study.

These initial conclusions needed further verification, of course, and the researchers recommended that additional testing be done using a scale model of the corridor. Previous success with scale models in fire research and the potential cost saving of such tests were two reasons cited for using a model rather than a full sized corridor.

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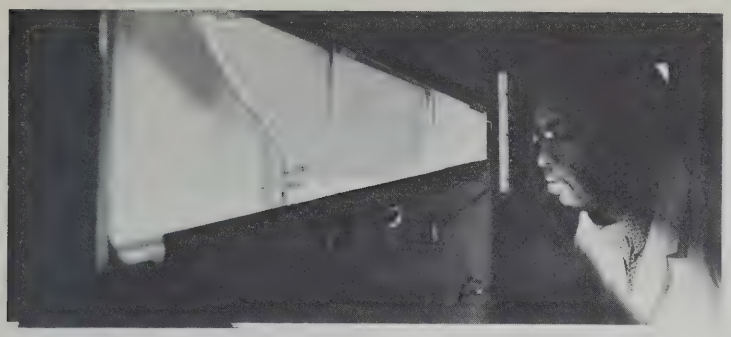
*A crib is a framework of wood strips assembled in a lattice pattern. It is designed to provide a reproducible fire source.

**The Research Associate Program has brought researchers from all areas of industry to NBS labs for over 50 years. For information, contact P. R. de Bruyn, NBS, Washington, D.C. 20234. Phone: 301/921-3591.

***Francis C. W. Fung, Miles R. Suchomel, and Philip L. Oglesby, "NBS Corridor Fire Tests: Energy and Radiation Models," NBS Technical Note 794, U.S. Department of Commerce.



The Model Corridor Program

In the process of designing a scale model corridor, NBS again was aided by the Research Associate Program. Wells Denyes, an employee of the Tennessee Eastman Company, came to NBS as a research associate under the sponsorship of the Man Made Fiber Producers Association, Inc., in August 1971 and stayed until January 1973. Working with the Bureau's James Quintiere, mechanical engineer, and James Raines, an engineering technician, Denyes designed the model corridor. Twenty-six carpet materials—donated by the Carpet and Rug Institute—and five other flooring materials were tested in the model corridor in the course of 369 flame spread experiments. The model was approximately one-fourth actual size.

The objective, according to Denyes and Raines, was "to develop a laboratory test procedure which would provide a high degree of confidence in predicting flammability and flame spread characteristics of floor coverings in full scale, real life situations."*

"The model corridor testing confirmed the results of the full scale corridor testing and went one step further. It told us once and for all that heat radiation was one of the controlling factors in these fires," says Huggett. Heat and smoke conducted from the burn room would accumulate in the upper portions of the corridor, heating the corridor floor surface by radiation. Whether or not flame-over occurred, then, depended largely on two factors: (1) the amount of heat energy radiated from the burn room to the corridor and (2) the properties of the corridor floor covering.

The fact that flooring system flammability could be modeled in small scale was crucial. It meant that, given the right test, corridor floor coverings could be ranked. This could be done by exposing the carpets to varying levels of heat radiation, igniting them, and then watching the fire's behavior. The radiant flux (heat energy) under which the carpet no longer sperads flame, called its *critical radiant flux,* would then be used as the basis for comparing floor coverings.

Finding the Right Test

The next step, then, was to find a test that uniformly determines critical radiant flux. Quintiere and Huggett analyzed various methods that might be applicable to floor coverings in corridor fires, rejecting all but one. The remaining candidate method (called the flooring radiant panel test) was under development by the Armstrong Cork Company. Originated in 1966, it incorporated the elements NBS research had thus far determined to be important in testing floor coverings in corridors. Primarily it was important because it included the effect of heat radiation on a floor surface. It was also considered more realistic than other test methods because sample floor covering was laid horizontally, face-up, the way corridor floor surfacing would be. (Other test methods hung carpeting upside down or placed it in a tilted position.)

Building the Apparatus

NBS, then, wanted the benefit of the research Armstrong Cork had done with what it called its flooring radiant panel apparatus. Here again it was the Research Associate Program which provided the necessary link as L. G. Hartzell, an Armstrong-Cork employee who had worked directly with the flooring radiant panel test, joined the NBS Program on Corridor Fires.

Hartzell came to NBS in February 1972, and stayed through March 1973. His job was to modify the flooring radiant panel apparatus at Armstrong Cork (known as AFRP-1), use a series of NBS test conditions to correct equipment and procedural problems, measure the effects of changes in test guidelines applied to the reconstructed flooring radiant panel apparatus (called AFRP-2), check other test characteristics of the equipment, and develop a method for analyzing data.

The major feature of the flooring radiant panel test is that it subjects floor covering samples to flame under varying amounts of heat radiation. The radiant panel giving off the heat is above, but slanted away from, the sample. At the point where the floor covering is closest to the panel, the heat radiation is greatest. That is where the sample is ignited by the small flame from the pilot source (see diagram 1). The distance the floor covering burns from the ignition point before the flame dies out is determined by this test. (The radiation from the panel keeps the flame alive, and the flame dies when there is not enough radiation to sustain it.) Since the amount of radiation provided by the panel is known for each point on the sample, measuring the distance the sample burns is equivalent to measuring the minimum radiation needed to sustain burning. This quantity is the "critical radiant flux."

The critical radiant flux scale was constructed so

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Wells Denyes and James W. Raines, "A Model Corridor for the Study of Flammability of Floor Coverings," NBSIR 73-200, U.S. Department of Commerce.

that measurements fell between 1.1 W/cm² (watts per square centimeter) and 0.1 W/cm². The higher the value, the less likely the sample is to propagate flame. In other words, the higher the critical radiant flux, the larger the room fire has to be before the carpet becomes involved. Carpeting taken from the Harmer House Convalescent Home was tested and shown to have a critical radiant flux of less than 0.1 W/cm².

With guidance from previous NBS corridor studies and the use of NBS laboratory facilities, plus the help of fellow associates at Armstrong Cork and other private industry assistance, Hartzell designed AFRP-2 and used it to execute a variety of performance tests. He found a high correlation between AFRP-1 and AFRP-2, and therefore concluded that the flooring radiant panel test was both repeatable and reproducible.

"Hartzell's work convinced us that we could use the flooring radiant panel test as a standard," says Huggett. "What remained was finalizing the standard and presenting it to the federal government and private industry."

The Research Associate Program again proved to be a valuable resource. With a background in materials research, C. Howard Adams, an employee of the Monsanto Company, came to the NBS Program on Corridor Fires from the Society of the Plastics Industry. Adams arrived at NBS in October 1973 and stayed until July 1975.

The NBS Program on Corridor Fires was reaching a new stage of development as Adams began his work at the Bureau. The prototype flooring radiant panel test provided a way in which flooring coverings for corridors could be tested under conditions that simulate the real world. What remained was to translate the concept into a workable test procedure. Adams accomplished this, and subsequently an interlaboratory program involving NBS and a variety of industries came into being.

At that time, Sanford Davis, who had recently joined the Bureau, took over the Furnishing Flammability Program. "The program on corridor fires was changing as I became chief," he recalls. "The necessary background research had been completed, and we became involved in testing what became known as the Flooring Radiant Panel."

Interlaboratory Tests

In the first phase of the project, NBS and the Man Made Fiber Producers Association (MMFPA) jointly coordinated tests to study the repeatability and reproducibility of the flooring radiant panel

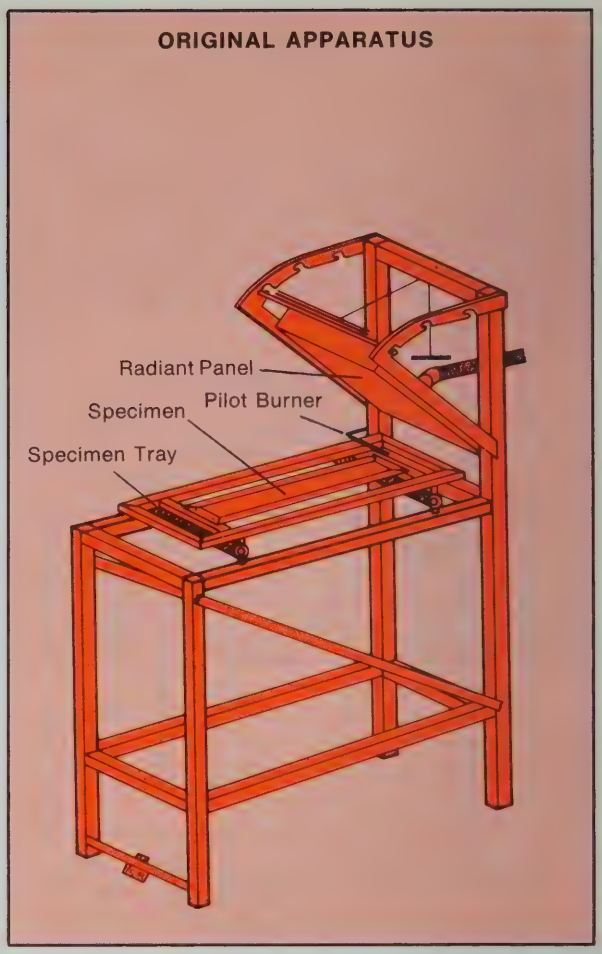
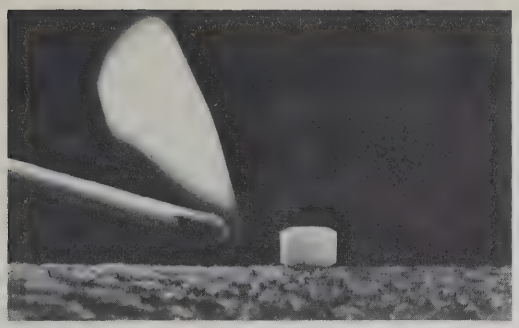


Diagram 1—*Diagram of AFRP-1. Notice that the pilot burner ignites the specimen at the point closest to the heat radiation.*

device. Thirteen laboratories tested 8 carpet systems (carpet or carpet plus padding). John Mandel, a statistical consultant in the NBS National Measurement Laboratory, analyzed the results and concluded that the test provided data of sufficient precision and reproducibility to support its use as a standard method.

In the second phase of the program, NBS and MMFPA were joined by the Carpet and Rug Institute. Testing in the first part of Phase II was basically the same as it had been in Phase I except that specimen samples were preheated for 2 minutes before being ignited. Twelve laboratories tested 10 carpet types and repeatability and reproducibility were again found to be very good. Later, in an additional test program, 64 carpet systems were used as a representative sample of the 800 or so on the market. Results showed that a number of carpets had a critical radiant flux equivalent to carpeting present in the Harmer House fire. However, some were also at the opposite end of the scale (see diagram 2).

Developments to this point substantiated the fact that the critical radiant flux would be an important additional element in quantifying fire performance of floor coverings. However, the actual levels of critical radiant flux that the coverings must meet is determined by state and local offi-



Methenamine pill test. It determines whether carpeting will burn when exposed to a small, flaming ignition source. Carpeting from the Harmer House passed the pill test.

cials and federal agencies that have jurisdiction over the facilities concerned. To set these levels, the officials must take into account many factors, including the first conditions expected in a corridor and the mobility of the occupants of the building. If these were the only considerations, it is likely that only coverings having a very high critical radiant flux would be allowed. But this would also mean that relatively few materials would meet the requirements, generally at substantial increases in cost. Thus, the overall assessment is a judgment that must balance a number of different, and often conflicting, aims.

One such assessment was made by Benjamin and Adams at NBS.* They suggested that officials consider requiring a minimum critical radiant flux of 0.25 W/cm² for carpeting in residential and commercial buildings, and 0.50 W/cm² for institutions like the Harmer House Convalescent Home. Individual jurisdictions have the option of picking higher or lower levels based on their own judgment of a particular situation. One of the principal virtues of the new test is that it provides one continuous scale which covers a wide range of performance.

By 1976, flooring radiant panel test devices were being marketed commercially and were turning up in major research labs in the United States. Now nearly 40 such devices are in use.

The Program Starts Having an Impact

In August 1975, the General Services Administration (GSA) called a meeting of all interested representatives of government agencies to hear the details of the NBS Program on Corridor Fires. Two years later, on August 31, 1977, Federal Test Method Standard #372, the test for Critical Radiant Flux of Carpet Flooring Systems (Flooring Radiant Panel Test), based on the NBS work, was required by GSA for all carpeting placed in corridors and exitways in federal bulidings.

After the government adopted the standard, attention focused on the private sector. As Davis says, "Many carpeting manufacturers already are using the flooring radiant panel test before they market carpet used in corridors or exitways. And certainly those that want to supply the federal government with that carpeting are complying."

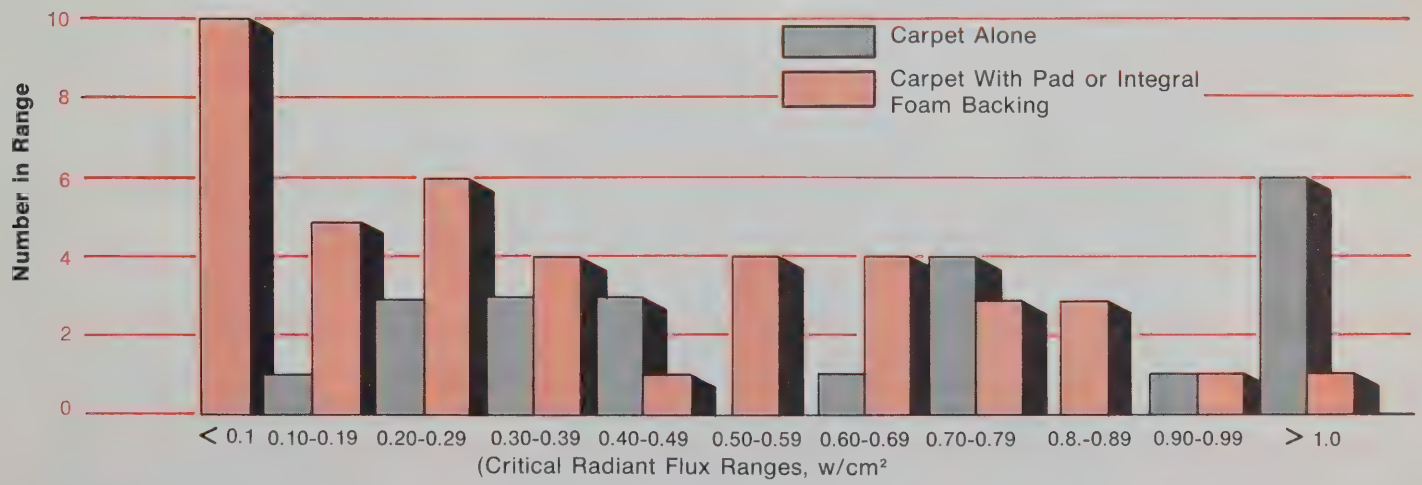
The National Fire Protection Association (NFPA), a private organization, adopted a standard similar to the one the General Services Administration had accepted, except that the NFPA standard applies to all floor covering material (for example, bare oak flooring is included) while the GSA study applies only to carpeting. The NFPA standard* was approved at the NFPA convention in May 1978.

Says Davis: "It will take a few years before these standards come into full force and are incorporated into state and local statutes for health care and nursing facilities. But the impact of the test is already beginning to be felt in facilities receiving federal funds, and we think a trend toward safer corridor floor covering is underway." □

Irwin A. Benjamin and C. Howard Adams, "Proposed Criteria for Use of the Critical Radiant Flux Test Method," NBSIR 75-950, U.S. Department of Commerce.

Called NFPA 253-1978, Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

Diagram 2—*Bar graph of the critical radiant flux ranges for the 64 carpet systems tested.*



TIME: Who Needs It?

by Collier Smith

IMAGINE for a moment that you are riding an elevator down from the 80th floor of the World Trade Center in New York City. It is a sweltering August day and you are glad to be in the cool confines of the air-conditioned skyscraper. Or are you?

You think: "Air conditioning, lights, motor . . . all need electricity. Power failure. Brownout. Blackout. 80 floors above the street. Stuck in an elevator-turned-oven."

You sigh with relief a few minutes later as you step out into the lobby. The lights are still on, and the beat of the big city throbs unchecked.

But that big beat has been stopped twice in the last 15 years. Twice New York City has been paralyzed by power blackouts. Brownouts have become almost common occurrences in some American cities during periods of extremely high electricity consumption when utility companies are forced to cut back power generation. The nation's utility companies have been trying to combat this problem by tracing trouble to its source so future power curtailments can be prevented. They have also been forming interconnecting power pools so that one utility can borrow power from another when its load outstrips its generating capacity.

In both of these efforts, the nation's utilities can be aided by time and frequency services provided by the National Bureau of Standards in Boulder, Colorado. Recently, NBS began broadcasting time signals from satellites, offering an even more useful signal to utility companies and other "customers."

Time and the Utilities

The electrical power generating industry needs accurate time information over a large geographical area because synchronization is useful in maintaining system reliability, constant frequency and voltage, and control of electric power flow. Finer synchronization is becoming more vital because of improved electronic instrumentation and, especially, computerized control and monitoring of large power networks.

Having better time information would permit utility companies to obtain more rapid and accurate interpretation of data in the event of a blackout. Without better timing, it would be more difficult to trace the cause of a blackout because dozens of circuit breakers can open almost simultaneously as a power surge moves through the system.

If utility company measuring instruments were all equipped with a means of recording the exact time in parallel with the data on sequence-of-events recorders and fault recorders (devices which monitor the power lines and record voltage variations, outages, and other kinds of problems), subsequent analysis of the records could more easily indicate where and how the fault originated, and corrective measures could be applied to prevent future failures.

Inter-utility power transfers would also benefit from better time information provided by a satellite. As demand for power outstrips the local supply in more and more areas of the country, such transfers of blocks of power are becoming common. Recently there have been suggestions that the entire continental United States should be interconnected in two or three huge networks so that peak loads and surplus capacity could be balanced better.

When two utilities are interconnected for power transfers, both must be operating at precisely the same phase and frequency to prevent surges that could destroy equipment or trigger circuit breakers. This phase and frequency matching is greatly aided by having both utilities synchronize their machinery using the same time standard, such as could be supplied via satellites.

Utilities would also be able to use the satellite time system to help maintain more accurate frequency standards throughout their systems. They want to maintain a frequency as close to 60 hertz (cycles per second) as possible because many commercial and residential customers have machines and instruments that are dependent upon line frequency (two common examples are electric clocks

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Researchers at the National Bureau of Standards in Boulder, Colo., keep the time with a clock system based on the vibration of a cesium atom. This system is in turn the basis for a variety of time and frequency dissemination services. Signals are available by radio, telephone, television—and lately, even by satellite. Who needs these services? Imagine you are riding an elevator . . .

Smith is a public information specialist with the NBS Boulder Program Information Office.

and phonograph turntables). The companies could use the satellite time signals as a reference for their frequency standards.

Environmental Applications

Another application of the satellite time code is to date precisely, down to the second, the environmental data gathered and recorded by hundreds of sensing platforms scattered all over the western hemisphere, and to set the clocks on self-timed platforms.

Data on temperatures, winds, ocean currents, stream flows, and other environmental phenomena are more valuable and useful if tagged with the exact time of measurement or observation. Other networks of sensors that plan to use the satellite time concept include tsunami ("tidal wave") warning systems, international magnetospheric study networks, and seismic networks for studying earthquake phenomena.

NBS has begun utilizing satellites for dissemination of very accurate time signals generated by NBS atomic clocks because other methods are becoming inadequate for a sizeable proportion of users. For example, NBS has been broadcasting standard time and frequency signals since 1923 from special radio stations.

Currently, NBS radio stations WWV and WWVH broadcast on the shortwave band between 2.5 and 15 MHz. The ionosphere, a layer of charged particles located high in the atmosphere, reflects radio waves in this frequency range back to earth, thus allowing over-the-horizon communication. These radio waves, called sky waves, can be reflected between ionosphere and earth many times, and the signals are often heard around the world.

The problem with this situation is that the height of the ionosphere is not constant from hour to hour, which causes the total path length between station and user to vary. This introduces substantial variations in the arrival times of the signals received by the user.

Increasing the frequency of the broadcasts would cause the signals to pass through the ionosphere instead of being reflected back to earth, and the range of transmission would be limited to little more than line-of-sight distances, as in television. Lower frequencies, such as the 60-kilohertz (kHz) signal of another NBS station, WWVB, are bounced between the earth and ionosphere, but the long wavelength of the signal and the height of the charged layer combine to produce destructive interference between the bounced sky wave and the direct ground wave at certain distances from the transmitter. Some areas on land and sea are left with a signal too weak to detect accurately and reliably.

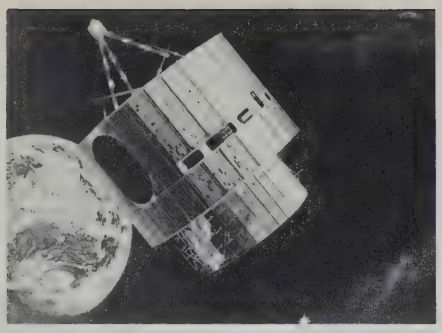
Right. The oval curves on the map delineate the coverage areas of the two satellites (located above the + marks). The 7° and 3° elevation angle curves indicate those locations on earth where the satellites appear to hover above the horizon.

The result of these effects is to make reception of ground-based transmissions unreliable and inaccurate for too many users. NBS needs a way to provide more accurate and reliable signals to users scattered all over the western hemisphere. Such a method is now at hand in the form of the Geostationary Operational Environmental Satellite (GOES) system. It is operated in conjunction with the National Oceanic and Atmospheric Administration, whose satellites are used in the system.

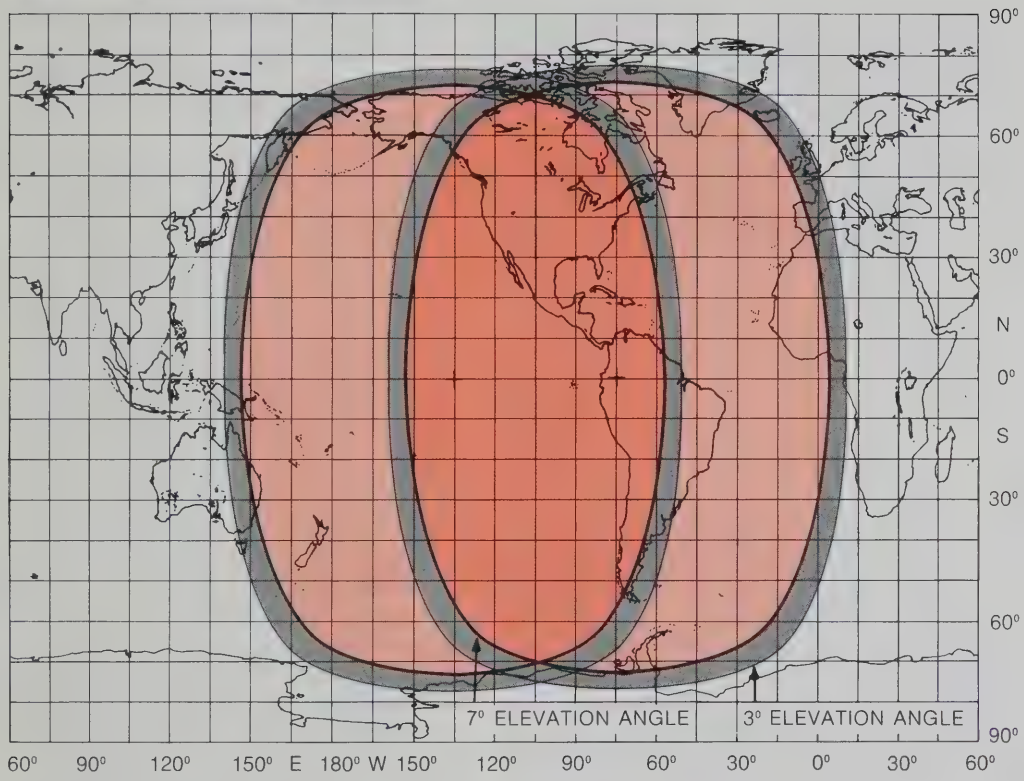
The two geostationary satellites used at present are located some 36 000 km (22 000 miles) above the equator. They are just high enough that their orbits take 24 hours, and the satellites appear to hang motionless above two spots on the equator, about 60° apart. Their extreme height enables each of them to broadcast to 40 percent of the world's surface, but they are placed so that their coverage overlaps in the United States, giving extra reliability there.

With the satellities so high, they can broadcast on line-of-sight paths to users in the coverage area, making ultra-high-frequency transmission feasible. This frequency, approximately 469 megahertz (MHz) is practically unaffected by the ionosphere, allowing very high accuracy and reliability of reception. Time delay variations due to ionosphere and troposphere (the lower atmosphere) can be kept as low as a few microseconds (millionths of a second), compared to variations of milliseconds (thousandths of a second) for shortwave ground-based transmissions, depending on propagation conditions and distances.

Another feature of the GOES system is that the user's clock and receiving equipment are relatively inexpensive. The receiver does not require a large or elaborate antenna; antennas a foot—30 cm—square and a quarter-inch—6 mm—thick are sufficient.



Left. Artist's conception of a GOES—a Geostationary Operational Environmental Satellite. Time signals are broadcast from two GOES.



Satellite-Controlled Clock and Users

Operation of the user's satellite controlled clock is relatively simple in concept. Time signals from one of the satellites set the internal quartz oscillator clock when the system is turned on. New comparisons are made continuously and the user's clock is adjusted automatically to match the satellite signal. If no signal is received from the satellite, the clock is inhibited from resetting; it just continues to run on its internal oscillator until it receives another signal.

The satellites obtain their time reference from atomic clocks located at the satellite ground station at Wallops Island, Virginia. These atomic clocks are kept in step with the NBS primary standards in Boulder, Colorado. Each satellite thus acts as a relay point in a chain extending from NBS standards to the user. The satellites receive the time from the ground station on a microwave beam, and instantly retransmit it back to earth at 468.825 MHz for the satellite at 135° west longitude and at 468.8375 MHz for the one at 75° west longitude.

Travelling at the speed of light, the time signal makes the round trip to a satellite in about a quarter of a second, and ordinarily one would expect a quarter-second delay in the user's clock reading. This problem is avoided, however, by advancing the time-code generator on the ground by 260 milliseconds. Thus when the signal arrives back on earth, it is within about 15 milliseconds of the correct time throughout the reception area. If the user knows his position on earth, he can further compensate for the delay to the level of about one millisecond.

Even more refined time, to a few microseconds, can be achieved by further corrections for the slight movements of the satellite. This correction can be done automatically by a microprocessor—a tiny computer—in the receiver clock, because data on satellite position are transmitted along with the time signal.

The NBS satellite time system thus offers users a relatively inexpensive source of more reliable, more accurate time information than was available at low cost before. Several commercial suppliers have already begun marketing clocks controlled by the satellite signals. As the system becomes better known, more equipment to utilize the signals will undoubtedly be made available to service needs only dimly perceived right now. □

NBS ASSISTS ELECTRONICS FIRM IN MEETING EUROPEAN STANDARD

by Frederick P. McGehan

The American electronics industry has run into a barrier in trying to sell some of its equipment in Europe, particularly in West Germany. Some recently manufactured American products have had difficulty passing rigid German standards intended to control electromagnetic radiation from electronic products. Some other European countries also refuse to admit U.S. products unless they can meet German standards.

Coming at a time when the American balance-of-payments deficit is at an all-time high, this barrier is of concern to both private industry and the federal government. In many respects, the problem is one of measurement discrepancies, and one electronics manufacturer has turned to the National Bureau of Standards for help.

In February, NBS and the Hewlett-Packard Company of Loveland, Colo., entered into a Research Associate Program* in which Hewlett-Packard engineers will work with NBS scientists in the Electromagnetic Fields Division in Boulder, Colo., to discover the reasons and remedy for the discrepancies found between Hewlett-Packard's measurements and those of the West German government. Three Hewlett-Packard engineers are spending two days a week at the Boulder Laboratories until the Research Associate Program is completed in October. The findings will be published and made available to the entire U.S. electronics industry.

W. Scott Bennett, a member of Hewlett-Packard's technical staff, said his firm became aware of the problem last fall when it sought approval to market a desk-top computer in West Germany. The correlation between American and German measurements for electromagnetic radiation "was not as good as we would have liked," he says, adding: "We're here [at NBS] to find out why there are discrepancies."

In addition to minimizing discrepancies between American and German measurements, Bennett hopes the Research Associate Program will improve the overall accuracy of electromagnetic interference (EMI) measurements. "We're looking for new measurement techniques that are relatively independent of the equipment being used to make the measurements," he says.

Initially, the Hewlett-Packard engineers thought the primary problem was simply that the Germans used a metallic screen ground-plane at their test site and Hewlett-Packard did not. NBS has such a facility. But the problem has turned out to be more complex.

Harold E. Taggart, an electrical engineer with the NBS Electromagnetic Fields Division, says there are "a number of factors" that may be causing the discrepancy in measurements. The electromagnetic signal given off by the desk-top computer is variably complex. "Sometimes it is a narrowband signal (single frequency), sometimes it is a broadband signal," Taggart notes.

"Accurate measurements of complex signals are difficult to make due to a number of factors such as signal polarizations, antenna and receiver impedances, and receiver bandwidths. In other words, significant measurement errors can be subtly introduced by the type of equipment used to make the EMI measurements," Taggart says.

One advantage of coming to NBS, he adds, is that the Bureau maintains radio frequency standards that may not be available in most private laboratories. NBS also has experts in a variety of measurement-related areas, including impedance, power, and voltage.

Taggart also points out that the Germans have had electromagnetic interference standards for consumer products for many years whereas the United States has become concerned about the EMI impact of consumer products only in recent years. Before that, he says, it was viewed primarily as a problem for military equipment. And military measurement procedures are not necessarily compatible with those for civilian environments. The American National Standards Institute is working with its European counterpart to try to close the gap in civilian measurement procedures, he adds.

Bennett notes that the Federal Communications Commission has proposed an electromagnetic interference regulation that would be even tighter than the present German standard. This has been precipitated by the increased pollution of the electromagnetic environment.

One immediate benefit of the NBS/Hewlett-Packard collaboration will be the sale within the United States of Hewlett-Packard electronic equipment that has less potential for electromagnetic interference. As the measurement procedures developed jointly by NBS and Hewlett-Packard become generally available through technical publications, other manufacturers may begin adopting the procedures as well. The long-term result will be a "cleaner" electromagnetic environment, both at home and abroad.

McGehan is a public information specialist with the NBS Program Information Office in Boulder, Colo.

* The Research Associate Program, a plan which has been in operation for over 50 years, enables engineers and scientists from companies and trade and professional organizations to work at NBS for specified periods of time on projects of mutual interest to their sponsoring organizations and NBS. For information, contact: P.R. de Bruyn, Industrial Liaison Officer, A402 Administration Building, National Bureau of Standards, Washington, D.C. 20234, 301/921-3591.

STANDARDS SAVE TAX MONEY

by Stan Lichtenstein

A recent joint effort by the United States Marshals Service (USMS) and the National Bureau of Standards promises a savings to taxpayers of over one-half million dollars.

With NBS assistance, the USMS adapted and applied previously developed standards to expedite the economical purchase of a large quantity of specialized radio equipment. The new equipment makes possible improved two-way radio communication through mobile units used by U.S. marshals in their field operations.

Five standards developed by the NBS Law Enforcement Standards Laboratory (LESL) for the Justice Department's National Institute of Law Enforcement and Criminal Justice became the basis for performance specifications and tests used by the Marshals in their contract award process. The standards were for mobile FM transmitters, receivers, and antennas; RF coaxial cable assemblies; and tone coded squelch. With 560 mobile transceiver (sending and receiving) units on its shopping list, the USMS found that the standards provided a vital quality control yardstick in the competitive bidding process.

The lowest bidder whose equipment met the standards was the General Electric Company. The first 110 units of communications equipment were purchased for $133 540, compared with a total of $235 757 if the same items had been purchased at the fully discounted General Services Administration's schedule price—a savings amounting to $102 217. A second group of 120 units, at $1249 each, resulted in an additional savings of $107,310. The contract is for a total of 560 units; when all are purchased, the net savings to the government will be over $504 000.

Marshall J. Treado, communications systems program manager for NBS/LESL, worked with the USMS to prepare the bid package used by the Service. Sample mobile transceivers were submitted by bidders and tested by the USMS to insure that they met the LESL-developed standards. The contract was then awarded to the lowest bidder whose equipment met the standards.

Police officer is shown using typical mobile radio communications equipment.

Lichtenstein is a public information specialist in the NBS Public Information Division.

STAFF REPORTS

ENCRYPTION STANDARD: VALIDATING HARDWARE TECHNIQUES

The National Bureau of Standards has built a hardware testbed facility to validate the techniques that manufacturers are using to implement the Federal Data Encryption Standard (DES). The DES algorithm, test facility, and validation procedures are described in this report.

Jason Gait, Systems and Software Division, A265 Technology Building, 301/921-3861.

The Data Encryption Standard was issued in January 1977 as Federal Information Processing Standard Publication (FIPS PUB) 46. The DES, when implemented in electronic devices, provides cryptographic protection for computer data that are transmitted and stored in computer systems. Federal agencies and departments needing such protection can purchase commercially available DES implementations that have been validated by NBS as conforming to the standard.

The DES is a complex non-linear ciphering algorithm that is capable of high-speed operation when implemented in hardware. Software implementations do not comply with the standard and are generally quite inefficient compared to hardware versions.

The DES algorithm converts 64 bits of plaintext to 64 bits of ciphertext under the action of a 56-bit keying parameter. The key is generated in such a way that each of the 56 bits used directly by the algorithm is random and the 8 error detecting bits are set to make the parity of each 8-bit byte of the key odd. Each member of a group of authorized users of encrypted data must have the key that was used to encipher the data in order to use it.

A block of data to be enciphered is subjected to an initial permutation, then to a complex key-dependent computation, and finally to a permutation which is the inverse of the initial permutation. The computation sequence is a series connection of sixteen rounds, one of which is depicted in figure 1.

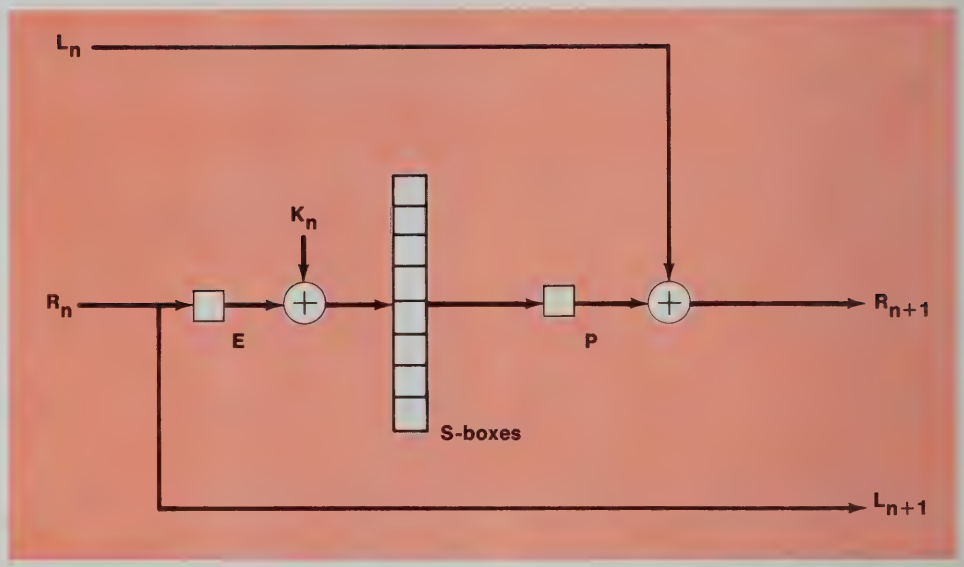


Figure 1—*One of the sixteen rounds of the DES. The sixteen rounds are connected in series and have an initial and final permutation. A key schedule determines the round keys.*

Each round uses 48 bits of the key in a sequence determined by a key schedule which provides for a thorough intermixing of the key bits for each round. With the exception of this difference in the round keys, the sixteen rounds are identical to one another. Each round receives an input of 64 bits; the 32-bit right half is expanded by the linear operator E to 48 bits and the result is mod two added to the round key; the 48 bit sum is divided into eight 6-bit blocks, each of which determines a 4-bit S-box entry; the resulting 32 bits are added mod two to the left half and the two halves are interchanged, thus producing 64 bits of output for the rounds.

The purpose of the permutations is to thoroughly mix the data bits so they cannot be traced back through the S-boxes, which are non-linear substitution tables. This technique strengthens the algorithm and makes it resistant to cryptanalytic attack.

The DES Testbed

The testbed includes a hardware implementation of the DES built by NBS in Transistor-Transistor Logic (TTL). This device performs an encryption or decryption of a 64-bit block of data in eight micro seconds and takes 26 micro seconds to load key or plaintext or to unload ciphertext. Figure 2 shows the DES testbed set up for the validation of a manufacturer's DES device.

The testbed uses a microcomputer, the NBS DES unit, the proprietary DES device and its interface to the microcomputer port, an operator's terminal (CRT), and a connection to the NBS computer (PDP 11/45). The latter operates in time-sharing mode using the UNIX operating system.

The microcomputer contains a small monitor program in read-only memory that is used to permit downstream loading of the validation software and test data from the PDP 11/45 files under control of the operator's terminal. The validation software was written and compiled on the PDP 11/45 using an in-house cross-assembler.

Validation Procedure

The DES validation procedure verifies that the manufacturer's hardware design of the DES correctly performs the algorithm. NBS does not certify the reliability

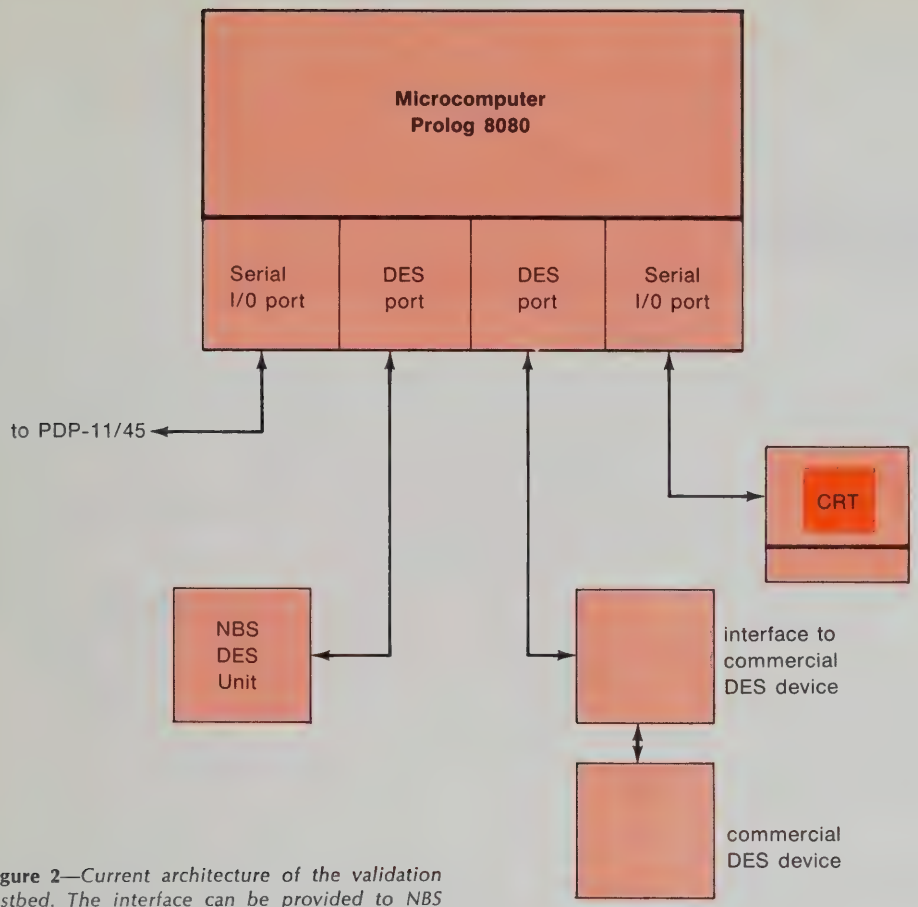


Figure 2—*Current architecture of the validation testbed. The interface can be provided to NBS with the hardware, or it can be built by NBS at cost from specifications of the proprietary hardware.*

of the DES devices; quality control is the responsibility of the manufacturer.

The manufacturer's device is interfaced to the microcomputer in parallel with the NBS DES unit. NBS can build the interface based on full specification of device characteristics provided by the manufacturer, or the manufacturer can provide his own interface that conforms to NBS design specifications.

The test set consists of 291 individual sets of key, plaintext, and ciphertext. Nineteen encryptions and comparisons are required to fully exercise the S-boxes. The key schedule is exercised by presenting 56 basic vectors for both encryption and decryption, an additional 112 tests. The initial and final permutations are tested by presenting to each permutation 64 basis vectors for 128 more tests, during which the expansion operator E is automatically verified. The permutation P is verified by performing 32 more encryptions.

The encrypted or decrypted data from the test device are compared with the result produced by the NBS DES unit. Any deviation in the comparison results in an error message being printed at the console, indicating which individual test failed. The normal execution time of this test is 3-5 minutes.

Since the test set is known, an additional series of Monte Carlo tests is performed using pseudo-random data to verify that the device has not been designed just to pass the test set. This test series also verifies that key or plaintext will not be exposed in place of ciphertext because of a design error.

The Monte Carlo test series consists of eight million encryptions and four million decryptions, with one decryption and two encryptions making up a single test. Each individual test consists of enciphering the plaintext on both the NBS and test devices, comparing the results, enciphering the ciphertext on both the NBS and test devices, comparing these results, then deciphering the output of the second encryption on the test device and comparing this with the first ciphertext. The key remains the same, while the output of the second encryption becomes the new plaintext. This process is repeated 10 000 times.

A new key is generated from the output of the first encryption that occurs in the 10 000th iteration of the first group of tests. This then becomes the key for another 10 000 iterations, and the process continues until 8 million encryptions and 4 million decryptions have been generated on the test device. Each group of 10 000 iterations takes approximately 1 minute to complete, and the entire series takes about 8 hours.

A message is printed out at the console indicating when each group of 10 000 iterations has been completed. The series is run until completion, or until an error is detected. If an error is detected, the current key, the plaintext, the result from the NBS device, and the result from the test device are printed out at the console. The error message states whether the error was in the first encryption, the second encryption, or the decryption.

Validation Service

A validation certificate will be issued to the manufacturer when the tests are successfully completed. The procedures for requesting validation services and for submitting devices are outlined in *Validating the Correctness of Hardware Implementations of the NBS Data Encryption Standard* (NBS Spec. Pub. 500-20). NBS charges for the cost of labor and materials used in performing the validation and in issuing a validation certificate. Federal agencies and departments procuring DES devices require that properly completed validation certificates be submitted by manufacturers.

In October 1977 NBS completed its first validation for a DES device manufactured by Collins Radio, a subsidiary of Rockwell International. Since then devices manufactured by IBM, Intel, Motorola, and Burroughs have also been validated, and more requests for the service are expected.

turn page

NEW APPARATUS FOR CRYOGENIC MEASUREMENTS

A new apparatus has been developed at the National Bureau of Standards for density and dielectric constant measurements on croygenic liquids, including liquid mixtures.

W. M. Haynes, Thermophysical Properties Division, Boulder, Colo., Room 2-1327, 303/499-1000, ext. 3247.

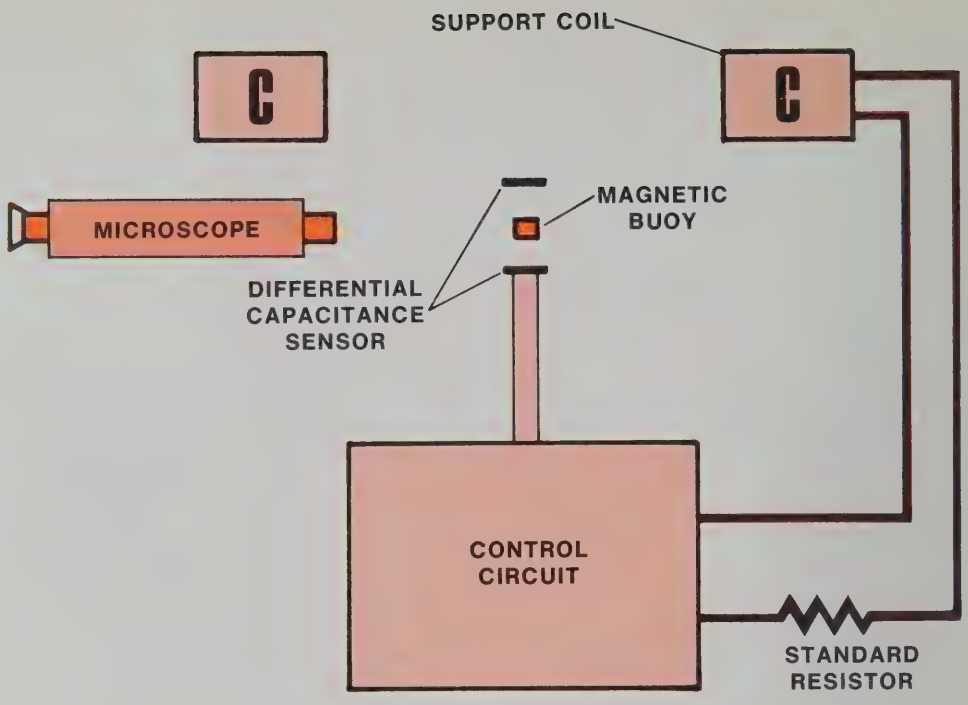


Figure 1—*Schematic diagram of magnetic suspension densitometer.*

We have developed an apparatus for pressure (P), temperature (T), density (ρ), composition (X), and dielectric constant measurements on liquids and liquid mixtures at temperatures between 70 and 320 K and at pressures to 35 MPa (350 bars). It can also be used for the acquisition of liquid-vapor equilibrium data for mixtures. It is significantly different from and more versatile than an earlier version* of a magnetic suspension densitometer developed at NBS.

A small magnetic buoy (barium ferrite) is suspended freely in a stable configuration through the automatic regulation of a closed-loop servosystem. Through measurements of the mass and volume of the magnetic buoy and of the current in an air-coil solenoid needed to support the buoy at the same position and temperature in vacuum and in the liquid of interest, the density of the liquid can be determined using Archimedes' principle. In the present apparatus the density of the buoy (5 g/cm^3) is significantly larger than the densities of fluids (0.3 to 1.3 g/cm^3) that will be covered here. This results in a total uncertainty for a single measurement of approximately 0.1 percent at low temperatures, decreasing to approximately 0.06 percent at room temperature. The imprecision of measurement is less than two parts in 10^4.

The new magnetic suspension densitometer features a differential capacitance sensor* for detection of the motion of the magnetic buoy, instead of optical or inductance sensing as used in the past. The sensor is immersed in the liquid sample inside a copper cell. By balancing a bridge of which the sensor is a part, the position of the buoy can be made insensitive to the dielectric constant of the sample fluid.

This apparatus also includes a capacitor with slotted concentric cylinders located just above the density sensor. It is used for simultaneous dielectric constant measurements on the fluids for which *PVTX* data are obtained. It has a capacitance of approximately 20 pF and can be read routinely to 0.0002 pF.

The apparatus is presently being used for orthobaric liquid density measurements on mixtures of liquefied natural gas (LNG) components (nitrogen, methane, ethane, propane, isobutane, normal butane). These measurements will serve as a basis for development of density calculational techniques used in LNG custody transfer applications. This work is sponsored by a consortium of eighteen energy companies, which includes both buyers and sellers of LNG in international trade. The density data can also serve as a basis for calibration or development of gauging and metering methods for LNG.

The dielectric constant measurements serve as a check on the consistency of the density results through use of the Clausius-Mossotti function. (Commercially available densitometers employing capacitance measurements are being used for LNG.) The dielectric constant data also provide information concerning molecular polarizabilities and interactions.

In a future study, the apparatus will be used for measurements on propane (a major constituent of LNG) at pressures to 35 MPa and at temperatures from its triple point (85.5 K) to 320 K. Measurements on equimolar liquid mixtures of nitrogen and methane to pressures to 35 MPa are also planned. These measurements will aid in the development of an equation of state for mixtures containing relatively simple molecular constituents. Significant quantities of nitrogen are present in most natural gases from the well; thus, accurate thermophysical property data for the nitrogen + methane system are needed in the design and operation of low temperature processes involving natural gas.

*W. M. Haynes, M. J. Hiza, and N. V. Frederick, *Rev. Sci. Instrum.* 47, 1237 (1976); W. M. Haynes, *Rev. Sci. Instrum.* 48, 39 (1977).

*The differential capacitance sensor was developed by N. V. Frederick, NBS Electromagnetic Technology Division, Center for Electronics and Electrical Engineering, National Engineering Laboratory, Boulder, Colo.

A SIMPLE MODEL FOR STABLE HIGH DENSITY DISCHARGES FOR LASERS

The rapidly increasing number of laser applications places greater importance on laser efficiency in converting electrical to optical energy. Improved energy conversion is particularly important for the high-power lasers needed for laser fusion. The National Bureau of Standards has developed a very simple model to explain the exceptional stability of a class of pulsed electrical discharges being explored for use in high-power, high-efficiency lasers.

Alan C. Gallagher, A709, 303/499-1000, ext. 3963, and Arthur V. Phelps, A400, 303/499-1000, ext. 3604, Quantum Physics Division, Joint Institute for Laboratory Astrophysics, University of Colo.

High power lasers require large energy depositions into the lasing medium, so that gaseous media are generally preferred due to their ability to recover quickly. When high-pressure gases are used, as in "excimer" lasers, it is relatively difficult to deposit electrical energy uniformly through the gas. Ordinary electric discharges tend to break up into filamentary arcs. One common method of overcoming this difficulty is with the use of high-energy electron beams (E-beams) that are accelerated in vacuum and sent through a thin foil into the gas. This is a relatively elaborate and inefficient excitation technique, requiring frequent replacement of foils as well, so other alternatives are desired. Another technique for avoiding arcs is to use a very short discharge pulse—typically, a few nanoseconds in duration. However, it is not practical to deliver a large energy to a large volume of gas in such short pulses.

Our investigations have shown that stable, high-power electric discharges can be obtained in some high-pressure gases without use of E-beams or very short voltage pulses, and even without gas preionization. In contrast to the behavior of highly non-equilibrium discharges commonly used for lasers, these discharges spread out with increasing current. They also exhibit a positive resistance characteristic so that they can, in principle, be operated without energy-wasting ballast resistors. These valuable properties are obtained in metal-doped noble gases at typical densities of 10^{19} to 10^{20} atoms per cubic centimeter. Discharge power densities of typically 10^4 to 10^5 W/cm^3 are delivered in pulses that are terminated after a few microseconds to avoid excessive gas heating.

We have developed models which explain the unusual electrical properties of these discharges as well as many of their observed optical emission features. The particular gas mixtures yield strong excimer emission bands that are potentially useful for high power lasers.

The models show that this behavior is to be expected at the high electron and gas densities and low gas temperatures of these discharges. For these conditions, the operating characteristics are determined by a balance between the input electrical power (i.e., the product of electric field and current density) and the energy given up to the gas when the free electrons recombine with the molecular positive ions. Recognition of the importance of this recombination process has provided a basis for predicting the excited state densities and laser characteristics to be expected for various gas mixtures as a function of discharge operating conditions.

This work has been supported by the Energy Research and Development Administration (now part of the Department of Energy), the Defense Advanced Research Projects Agency, and the Air Force Weapons Laboratory.

STANDARD POLYMER SOLUTIONS FOR RHEOLOGY

One Standard Reference Material and one Research Material are now available for use in calibrating and checking instruments used to determine non-linear rheological properties.

Standard Reference Material 1490 is a 10 percent solution of polyisobutylene in cetane, and Research Material 40 is a 7 percent solution of polystyrene in a mixed solvent that has the same index of refraction as the polystyrene at 25 °C.

These standard polymer solutions can be used to calibrate and check instruments in those industries where polymer melts or solutions are highly sheared (as in modern processing and forming methods). Measurements of non-linear rheological properties are used to monitor this type of processing with plastics, rubbers, suspensions and colloids (such as inks and paints), rocket fuels, adhesives, sealants, lubricants, biological fluids, foodstuffs, and many other commercial liquids.

Values of the viscosity and first normal stress difference are given as a function of shear rates at 25 °C for both materials. Values of the zero shear viscosity are also given at other temperatures. SRM 1490 has a low flow activation energy and long shelf life. RM 40 has a high flow activation energy that makes it useful for the study of viscous heating or for calibrating thermal effects superimposed on flow measurements. It will also be useful for flow birefringence measurements and general studies of non-viscometric flows.

The polyisobutylene solution, SRM 1490, is issued in 250-milliliter quantities for $169. The polystyrene solution, RM 40, is issued in 250-milliliter quantities for $223. These materials may be ordered from the Office of Standard Reference Materials, Room B311, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

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SUPERCONDUCTING MICROCIRCUIT FABRICATION

Instruments and standards based on the Josephson junction no longer need be limited to only one or two junctions. Now the National Bureau of Standards is using photolithography to develop complex superconducting microcircuits. Facilities have been set up to perform all aspects of the fabrication process—from making the masks which contain the patterns for these tiny devices (with resolution down to a few micrometers) to applying thin films under vacuum. Ultimately these processes will be used to fabricate superconducting integrated circuits for improved instruments and standards.

R. E. Harris, C. A. Hamilton, R. L. Kautz, and D. G. McDonald, Electromagnetic Technology Division, Boulder, Colo. 303/ 499-1000.

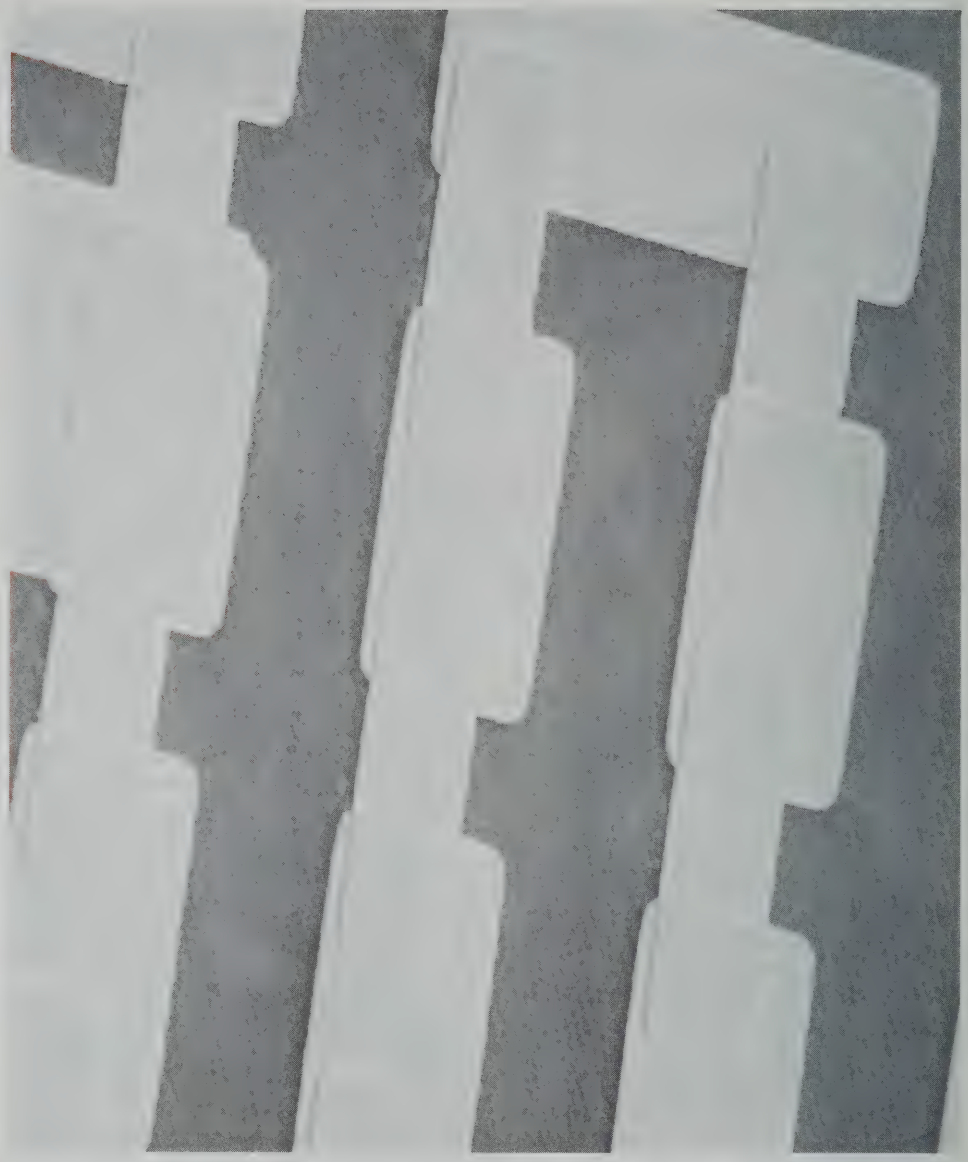

Figure 1—*Scanning electron microscope image (575 × magnification) showing a portion of an array of 5276 Josephson junctions in series. The junctions are formed where the thin films overlap. Each is about 15 × 15 micrometers.*

Facilities for the fabrication of superconducting microcircuitry using photolithography have been established recently at the National Bureau of Standards in Boulder, Colo. Prior to establishment of the facility, NBS research using Josephson junctions had been confined to circuits in which only one or two Josephson elements were used, with the remaining circuitry consisting of conventional electronics.

Complex superconducting circuitry will not only allow improvement in previous Josephson instruments and standards but also will make possible a whole range of new applications. In particular, picosecond time-scale current comparators, sample-and-hold circuits, counters, and analog-to-digital converters are possible when these new microfabrication methods are used. The work is stimulated by a large effort at IBM Research to develop this technology for ultra-fast computers.

The facility is divided into two parts: one for producing photolithographic masks and the other for fabricating thin film circuits. The fabrication processes use photographic masks with a resolution of a few micrometers. Two pieces of equipment are used in this process, a digitally controlled pattern generator and a step-and-repeat camera. The latter device reduces the size of the pattern generator masks by a factor of ten and repeats the pattern as many times as required, locating the images with a precision of 250 nanometers.

Literally millions of Josephson junctions have been produced in the facility. Their high quality is determined from conventional standards, such as the details of the junction current-voltage characteristic. Also, data show the junctions are capable of surviving 10 to 20 thermal cycles between room and liquid helium temperatures. Resistance changes, which occur when junctions are stored at room temperature, are prevented by storage in a conventional refrigerator. Although these results are remarkable when compared with those possible a few years ago, even further improvement is expected.

In addition to junctions, superconducting microstrip lines and thin film resistors have been fabricated, thus completing the necessary catalog of components necessary for fabrication of entire superconducting integrated circuits. Detailed design work is in progress which will make possible the use of this new technology for improved instruments and standards.

STANDARD REFERENCE MATERIALS FOR CEREAL FOODS

Two flour Standard Reference Materials are now available from the NBS Office of Standard Reference Materials. They are characterized mainly for trace elements including selected nutrients and environmentally important constituents. The SRM's are intended for evaluating the accuracy of trace element concentrations in flour and other cereal foods and for calibrating the analytical instrumentation used in such determinations.

The chemical composition of cereal foods is of special interest to environmentalists, medical researchers, nutritionists, and other food scientists because of the large consumption of such foods throughout the world. For example, the U.S. population obtains approximately one-fourth of its total caloric content from cereal foods, much of which is consumed as refined flour in bread or other bakery products.

Quantitative data are needed on the trace element composition of cereal foods, which have been processed by different methods from crops grown under various conditions. These data may be acquired over a long-term period by a number of investigators working in different laboratories. The efficiency and reliability of the analyses can be improved by analyzing the samples relative to two new Standard Reference Materials: SRM 1567, Wheat Flour, and SRM 1568, Rice Flour. Of particular importance are environmental elements, such as cadmium and mercury, and micronutrients such as iron, zinc, copper, manganese, selenium, and molybdenum. The present Recommended Dietary Allowances gives values for iron and zinc, and its 1978 revision is expected to include provisional RDAs as ranges for the other four micronutrients.

The Certificates of Analysis for SRM's 1567 and 1568 list certified concentrations for potassium, calcium, and the following trace elements: iron, zinc, manganese, sodium, copper, selenium, cadmium, and mercury. In addition, SRM 1568 is certified for arsenic and cobalt. The concentrations of the following elements are not certified, but given for information only: bromine, rubidium, molybdenum, nickel, and tellurium. Also, for SRM 1567, the arsenic concentration is given but not certified. The methods used for the analytical determinations were: atomic absorption spectrometry, flame emission spectrometry, isotope dilution spark source mass spectrometry, neutron activation, and polarography.

The request and partial support for the technical work leading to certification of these SRM's came from the U.S. Food and Drug Administration.

Standard Reference Materials 1567, Wheat Flour, and 1568, Rice Flour, may be purchased from the Office of Standard Reference Materials, National Bureau of Standards, Washington, D.C. 20234, for $73 per 80-gram sample.

TWO NICKEL STANDARD REFERENCE MATERIALS

The National Bureau of Standards' Office of Standard Reference Materials announces the availability of two cupro-nickle (10 percent Ni) Standard Reference Materials.

Two new Standard Reference Materials (SRM's) meet the chemical composition specifications for CDA Alloy 706. SRM 874, designated "high-purity," has the residual content of trace elements of particular importance to the nuclear industry; SRM 875, designated "doped," has added amounts of these trace elements. Both SRM's are intended for use in chemical and instrumental methods of analysis. They are in the form of fine granules produced by water atomization at the Paul D. Merica Research Laboratory of the International Nickel Company.

This cupro-nickel alloy is widely used in condensers, distiller tubes, evaporation and heat exchanger tubes, ferrules, and salt water piping. It is also finding increased use in nuclear applications.

Both SRM's also are certified for Zn, Pb, Mn, Sb, Sn, P, Bi, Cd, and Se. Although not certified, additional information on the composition is given for O, H, C, S, Mg, As, Si, Ti, and Te.

The cooperative analyses for certification were carried out under the auspices of the American Society for Testing and Materials—NBS Research Associate Program.

The Cupro-Nickel SRM's 874 and 875, may be purchased from the Office of Standard Reference Materials, B311 Chemistry Building, NBS, Washington, D.C. 20234. They are sold in units of 100 g for $48 per unit.

Table 1—Composition for the specified element in each of the two SRM's is as follows (wt %):

Standard Reference Material 874 Cupro-Nickel, 10% (CDA 706) "High-Purity"

Cu	Ni	Fe
88.49	10.18	1.22

Standard Reference Material 875 Cupro-Nickel, 10% (CDA 706) "Doped"

Cu	Ni	Fe
87.83	10.42	1.45

CONFERENCES

For general information on NBS conferences, contact Sara Torrence, Public Information Division, Washington, D.C. 20234, 301/921-2721.

BEHAVIOR IN FIRES SEMINAR

The National Bureau of Standards will host a seminar on behavior in fires, October 30 through November 1, 1978, at the Bureau's headquarters in Gaithersburg, Md.

The purpose of the informal seminar is to bring together researchers in this newly emerging field to learn about current research projects and to discuss methodological and other problems of mutual interest. All participants will have an opportunity to present a paper on their recent research.

The behavior of people in fires is a new area of interest to psychologists, sociologists, architects, and fire protection engineers in the United States, Canada, Great Britain, Japan, and Belgium. In 1977 a group of researchers met at the University of Surrey in England to discuss their latest research, methodological problems, and potential application of the research. The group agreed to meet again at the National Bureau of Standards in 1978.

The seminar will be limited in attendance to encourage informality and active participation of all concerned. Attendees should be engaged in research in the area of behavior in fires. The seminar may run parallel specialized sessions part of the time to foster small group interaction and to permit organized discussion of special interest topics.

For further information contact: Dr. Bernard Levin, B142 Technology Building, 301/921-3143.

ELECTROMAGNETIC POLLUTION MAJOR WORKSHOP

The National Bureau of Standards will sponsor a major workshop on the growing problem of "electromagnetic pollution" at its Gaithersburg, Md., headquarters on November 2 and 3, 1978.

Electromagnetic pollution, known technically as electromagnetic interference (EMI), is caused when an electronic device radiates an electromagnetic signal which interferes with the operation of another electronic device. Some observers believe that EMI may become one of the top environmental problems in the 1980's because of the proliferation of electronic products and components in American life.

One aspect of the EMI problem, microwave radiation, has received considerable public attention in recent months. But the problem is broader: it can be harmless (such as snow on a TV screen) or life threatening (such as the failure of a truck's electronic braking system); it can disable a sophisticated military missile or a mammoth computer; it can foul-up electronic banking or the fuel-injection system of a new car.

The purpose of the workshop, arranged by NBS' Electromagnetic Fields Division located in Boulder, Colo., will be to bring together manufacturers, consumers and government agencies for a common dialogue. This will be the second consecutive year that NBS has sponsored an EMI workshop. Unlike some other, more technical meetings, the NBS workshop is designed for the decision maker rather than the bench scientist. It will provide a forum in which current technical and regulatory problems can be aired and future problem areas can be identified.

The workshop will consist of overview presentations followed by five separate discussion groups. These groups will include the transportation, communications, medical, industrial and consumer product aspects of the EMI problem. The workshop will close with a general session that sums up the conclusions of the five panels.

Persons interested in attending the workshop or obtaining more information should contact Mrs. Dee Belsher, Program Information Office, NBS, Boulder, CO 80303, 303/499-1000, ext. 3981.

WINTER SIMULATION CONFERENCE

The 1978 Winter Simulation Conference (WSC 78), to be held December 4-6, 1978, in Miami Beach, Florida, will feature papers and panel discussions on discrete and combined (discrete/continuous) simulation.

Cosponsored by the National Bureau of Standards and leading organizations sharing an interest in computer simulation, WSC 78 will hear papers on a broad range of simulation topics at three types of sessions devoted, respectively, to tutorials, methodology, and applications.

The tutorial sessions will feature state-of-the-art summaries of simulation methodology (languages, techniques, data analysis) as well as fields of application.

Topics for papers on methodology and applications will include:

Simulation Methodology

Experimental Design, Language Developments, Statistical Analysis, Debugging Aids, Validation Techniques, Human Interfaces, Education and Training, and Random Number Generation.

Simulation Applications

Information Systems, Data Base Systems, Computer Systems, Planning Models, Scheduling, Logistics and Networks, Reliability Control, Financial Models, Communications, Agriculture and Forestry, Energy, Health, Industry, Government, Transportation, Education, and Military.

Cosponsoring WSC 78 with NBS are the American Institute of Industrial Engineers; Systems, Man, and Cybernetics Society of the Institute of Electrical and Electronics Engineers (IEEE); Operations Research Society of America (ORSA); College of Simulation and Gaming of the Institute for

Management Sciences (TIMS); and the Society for Computer Simulation.

For further information contact: Dr. Norman R. Nielsen, WSC 78 Program Chairman, Information Science Laboratory (J-1041), SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, Phone: 415/326-6200, ext. 2859.

CONFERENCE CALENDAR

SYMPOSIUM ON ATOMIC AND MOLECULAR SCIENCE AND TECHNOLOGY, NBS, Gaithersburg, MD; sponsored by NBS; contact: Stephen Smith, NBS, Boulder, Colo., 303/499-1000, ext. 3631.

September 18-22

CHARACTERIZATION OF HIGH-TEMPERATURE GASES, NBS, Gaithersburg, MD; sponsored by NBS, contact: J. Hastie, A307 Materials Building, 301/921-2859.

***September 27-29**

FIRE RESEARCH CONFERENCE, NBS, Gaithersburg, MD; sponsored by NBS; contact: Clayton Huggett, B142 Technology Building, 301/921-3771.

***October 4-5**

CORROSION CONFERENCE, University of Maryland, sponsored by NBS, DOT, and NACE; contact: Paul Campbell, B352 Building Research Building, 301/921-3114.

October 4-6

NATIONAL CONFERENCE OF STANDARDS LABORATORIES, NBS, Gaithersburg, MD; sponsored by NBS and the National Conference of Standards Laboratories; contact: Brian Belanger, A345 Physics Building, 301/921-2805.

October 10-12

3RD ANNUAL CONFERENCE ON MATERIALS FOR COAL CONVERSION AND UTILIZATION, NBS, Gaithersburg, MD; sponsored by NBS and DOE, contact: Samuel Schneider, B308 Materials Building, 301/921-2894.

***October 30 — November 1**

SEMINAR ON HUMAN BEHAVIOR IN FIRES, NBS, Gaithersburg, MD; sponsored by NBS; contact: Bernard Levin, B142 Technology Building, 301/921-3845.

***November 2-3**

ELECTROMAGNETIC WORKSHOP, NBS, Gaithersburg, MD; sponsored by NBS; contact: Dee Belsher, NBS, Boulder, Colo., 303/499-1000, ext. 3981.

November 13-15

CERAMIC MACHINING AND SURFACE FINISHING II, NBS, Gaithersburg, MD; sponsored by NBS, Office of Naval Research, Air Force Office of Scientific Research, and the American Ceramic Society; contact: Bernard Hockey, A345 Materials Building, 301/921-2901.

November 28-30

MECHANICAL FAILURES PREVENTION GROUP, San Antonio, Texas; sponsored by NBS and MFPG; contact: Harry Burnett, B264 Materials Building, 301/921-2813.

December 4-6

WINTER SIMULATION CONFERENCE, Miami Beach, FL; sponsored by NBS; American Institute of Industrial Engineers; Systems, Man, and Cybernetics Society, Institute of Electrical and Electronics Engineers; Operations Research Society of America, College of Simulation and Gaming, The Institute for Management Sciences; and Society for Computer Simulation, The Deauville Hotel, Miami Beach, Fla.; contact: Paul F. Roth, B250 Technology Building, 301/921-3545.

1979

***April 19-20**

5TH ROOFING TECHNOLOGY CONFERENCE, NBS, Gaithersburg, MD; sponsored by NBS and NRCA; contact: William Good, National Roofing Contractors Association, Oak Park, IL, 312/383-9513.

***May 17**

TRENDS AND APPLICATIONS SYMPOSIUM, NBS, Gaithersburg, MD; sponsored by NBS, and IEEE; contact: Shirley Watkins, B212 Technology Building, 301/921-2601.

***June 11-15**

SYMPOSIUM ON ACCURACY IN POWER DIFFRACTION, NBS, Gaithersburg, MD; sponsored by NBS, National Research Council of Canada, and the International Union of Crystallography; contact: Stanley Block, A219 Materials Building, 301/921-2837.

*New Listings

PUBLICATIONS

DIRECTORY—LAW ENFORCEMENT

Directory of Law Enforcement and Criminal Justice Associations and Research Centers, Law Enforcement Standards Laboratory, Nat. Bur. Stand. (U.S.), Spec. Publ. 480-20, 51 pages (Mar. 1978), Stock No. 003-003-01904-6, $2.20.

This is a directory of organizations that are active in one or more areas of the criminal justice system, including law enforcement, courts, corrections, rehabilitation. The directory lists national organizations primarily, but also includes regional organizations and local organizations of special interest as well as international organizations which have a significant number of American members, a U.S. chapter or subcommittee, or are doing work applicable to law enforcement in this country.

The types of national law enforcement and criminal justice organizations listed in this directory are limited by the criterion that they be nonprofit. Included in this category are professional and volunteer social action associations, research centers (usually connected with a university), and government agencies. Strictly social or fraternal organizations are not listed.

The information about each organization in this directory forms a separate entry. Each entry contains the following information: (1) the full title of the organization and its acronym, where applicable; (2) the mailing address; (3) the name of an incumbent officer; (4) the telephone number at which a contact person can be reached; (5) the year when the organization was founded; (6) the number of members; (7) the number of staff, where applicable; (8) a brief description of the purpose and activities of the organization; (9) affiliations, if any; (10) publications, if any; and (11) the date and place of the next meeting or convention, or when they generally occur. There are entries which do not contain any more than the first four of the above data items. In these cases it was not possible to obtain further information before the deadline for publication of the directory.

The first edition of this directory was developed primarily by scanning the Encyclopedia of Associations, the Research Centers Directory, and other general directories, and extracting from them the data on organizations relating to law enforcement and criminal justice. Whenever personal investigation revealed organizations which were not included in the primary source material, they were included in this directory.

Once the information was obtained from the general directories it was verified by telephone or by mail. Although in some cases it was not possible to obtain verification of the descriptions of the organizations, the names, mailing addresses, officers and telephone numbers for all entries are accurate as of June 1977.

The organizations are listed alphabetically. A subject index, which is located at the back of the directory, is cross-referenced and is based solely on information given in the descriptions of activities.

The first edition of this directory was prepared by B. J. Latka of the Law Enforcement Standards Laboratory (LESL) and was issued in June 1973 as NBS Technical Note 752. This thoroughly revised and updated second edition is the result of the efforts of several LESL staff members.

PROCEEDINGS OF DATA ELEMENTS MANAGEMENT SYMPOSIUM

Proceedings of the Third National Symposium on Management of Data Elements are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, at $8 a paper copy (155 pages) and $3 for microfiche. Cite the title and reference number PB-279-661 when ordering.

How to streamline the handling of vast amounts of data—"man's oldest resource"—is a problem given expert scrutiny from various standpoints in a new publication of the National Bureau of Standards.

Featured in the publication are analyses by 27 speakers discussing data element management in health care, energy information systems, data dictionary/directories, data resource management, international trade, and natural history museums. Also included are the highlights of the Findings and Final Report of the Commission on Federal Paperwork, as well as details of the Federal Information Locator System.

The publication represents the proceedings of the Third National Symposium on the Management of Data Elements in Information Processing, held at NBS in Gaithersburg, MD, on September 28-30, 1977. The symposium was jointly sponsored by the Bureau and the American National Standards Institute's Committee X3L8 on the representation of data elements. Several hundred professionals from the public and private sectors participated in the symposium's five sessions, approaching data as a resource that needs to be harnessed, costed, and managed.

TRACE ELEMENTS IN BIOLOGICAL AND BOTANICAL MATERIALS

Procedures Used at the National Bureau of Standards to Determine Selected Trace Elements in Biological and Botanical Materials, Mavrodineanu, R., Nat. Bur. Stand. (U.S.), Spec. Publ. 492, 295 pages (Nov. 1977), Stock No. 003-003-01858-9, $7.50.

This volume consists of 13 papers describing the analytical procedures selected at the National Bureau of Standards for the determination of the following elements in biological and botanical materials:

Silver, Aluminum, Arsenic, Beryllium, Bismuth, Calcium, Cadmium, Chromium, Copper, Iron, Mercury, Potassium, Magnesium, Manganese, Molybdenum, Sodium, Nickel, Lead, Platinum, Antimony, Selenium, Tellurium, Thallium, Vanadium, and Zinc.

These procedures, used at the present time for the certification of various substances issued by NBS as Standard Ref-

erence Materials, apply to the following: neutron activation analysis, spark source mass spectrometric isotope dilution, atomic absorption and flame emission spectrometry, molecular absorption spectrometry, fluorescence spectrometry, and polarography.

Further details on the analytical methods including sample preparation, purity of reagents, and problems associated with blanks are given in 16 additional papers which are reproduced in the Appendix to this volume.

Building Technology

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Cali, J. P., and Plebanski, T., Standard Reference Materials: Guide to United States Reference Materials, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-57, 55 pages (Feb. 1978) Stock No. 003-003-01883-0, $2.20.

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Publications cited here may be purchased at the listed price from the U.S. Government Printing Office, Washington, D.C. 20402 (foreign: add 25%). Microfiche copies are available from the National Technical Information Service, Springfield, VA 22161. For more complete periodic listings of all scientific papers and articles produced by NBS staff, write: Editor, Publications Newsletter, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

NEWS BRIEFS

DO YOU NEED AIR CONDITIONING? Ventilating a residence with a "whole-house fan" instead of an air conditioner can be a very effective way to save energy. That's what NBS researchers found in tests run in Houston, Texas. Cosponsored by the Department of Energy, the research project gave a general indication that the whole-house fan could take the place of an air conditioner during a significant portion of the summer in the northern half of the U.S. It could also save substantial amounts of energy in the South, according to NBS. The whole-house fan is mounted in the ceiling of the living area and draws a breeze through open windows of the house, providing a cooling effect when the temperature outside is less than 28 °C.

SAVINGS IN COMPUTER PROCUREMENT. Three computer interface standards that will help the U.S. Government trim the cost of buying new computer peripheral equipment have been proposed by NBS. They apply to the input/output channel level interfaces of all medium and large scale computer systems. They cover the I/O channel interface, the power control interface, and the channel level operational specifications for magnetic tape. A fourth, giving operational specifications for magnetic disk equipment, is under development for proposal in the year ahead.

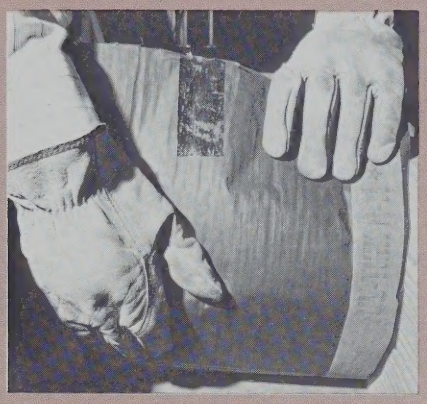
ICC CONSIDERING REGULATORY CHANGE. An experiment is planned to determine whether the public would benefit if certain regulations affecting truck and rail transportation were dropped. NBS will assist the Interstate Commerce Commission in designing the experiment, which will focus on ICC rate and service regulations.

MEETING ON THERMAL PROPERTIES OF PETROLEUM. The American Petroleum Institute and NBS will conduct a special joint workshop on the thermal properties of petroleum at the NBS complex in Gaithersburg, MD, from 10 AM to 5 PM on September 11. The workshop will discuss new data that will be the basis for API's review of API Standard 2540 (ASTM D1250) on the coefficient of thermal expansion of petroleums. The standard is in daily use around the world for the custody transfer of oil and the design of oil handling equipment. The new data were developed for the API by NBS. The workshop is open to anyone wishing to attend. For further information contact Michael Baum, 301/921-3181.

CHALLENGES IN ATOMIC AND MOLECULAR SCIENCE. Atomic and molecular science will be the focus of a special symposium conducted by NBS in Gaithersburg, MD., on September 7 and 8. The meeting will be the second in the series on "Challenges in Science and Technology" being sponsored by NBS during 1978 and 1979. For further information contact Mrs. Alice Dugan, A537 Administration Building, NBS, Wash., D.C. 20234.

NEXT MONTH IN

DIMENSIONS/NBS



Don't waste time worrying about whether to add more insulation to your house. Read about insulation in the next issue of DIMENSIONS/NBS.

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